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# Aerodynamic Performance of Axial-Flow Fan Stage Operated at Nine Inlet Guide Vane Angles

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and Space Administration

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## SUMMARY

The overall performance of a fan stage suitable for vertical-lift aircraft is presented for nine inlet guide vane angle settings. Data were obtained over the stable flow range at speeds from 60 to 120 percent of design for vane setting angles from  $-25^{\circ}$  to  $42.5^{\circ}$ . At design speed and design inlet guide vane angle, the stage had a peak efficiency of 0.892 at a pressure ratio of 1.322 and a flow of 25.31 kilograms per second. The stall margin based on flow and pressure ratio at peak efficiency and stall was 20 percent.

Based on an operating line passing through the peak efficiency point at the design setting angle, the useful operating range of the stage at design speed is limited by stall at the positive setting angles ( $32.5^{\circ}$ ) and by choke at the negative angles ( $-17.5^{\circ}$ ). The calculated static thrust along the operating line varied from 68 to 114 percent of that obtained at the design setting angle.

## INTRODUCTION

The research program on axial-flow fans and compressors for advanced air breathing engines being conducted at the NASA Lewis Research Center is primarily directed toward improving the performance and reducing the size, weight, and cost of these components. As a part of this program, experimental studies have been conducted on fan stages with variable-pitch-rotor-blades suitable for use in engines for powered-lift aircraft (refs. 1 to 7). The results from these investigations indicated that some of the various flight requirements could be achieved using engines with such fan stages.

The Lewis Research Center is studying various engine concepts for vertical-lift aircraft. Not only are the cruise requirements more demanding than those for powered-lift aircraft, there is also a takeoff and landing requirement that the thrust for each engine be varied to provide aircraft stability control. Two of the methods being considered for varying the thrust are the use of variable-pitch rotor blades and the use of variable inlet guide vanes. The performance of a fan stage with variable-pitch rotor blades operating over a range of angle settings is presented in reference 8. The performance of the same fan stage with the rotor blades at a fixed setting angle is presented in the report for nine inlet guide vane angles.

The variable inlet guide vanes were designed and fabricated by Hamilton Standard Division of the United Technologies Corporation to be added to the 1.38-pressure-ratio variable-pitch-rotor fan stage previously tested. The stage with the inlet guide vanes

was tested by Lewis at speeds from 60 to 120 percent of design and inlet guide vane angles from  $-25^{\circ}$  to  $42.5^{\circ}$ . It was anticipated that this angle variation would give a significant range in fan thrust at design speed. This report presents the overall performance of the stage operated at nine inlet guide vane setting angles.

## TEST STAGE

The test stage (figs. 1 and 2), designated stage 57M2, was designed and fabricated by the Hamilton Standard Division of the United Technologies Corporation. The rotor and stator are those described in reference 8. The inlet guide vanes (IGV's) were designed to be added to that stage. From the previous tests on the fan stage (ref. 8), it appears that the efficiency would be optimum at a rotor setting angle of  $6^{\circ}$  (closed). Thus the rotor-blade setting angle for stage 57M2 was set at  $6^{\circ}$ . The casing diameter above the rotor tip was constant, and the rotor was machined to have a constant clearance from blade leading to trailing edge. The 20 inlet guide vanes were of NACA 63-009 series profiles. In their design position the vanes are aligned to the axial direction. As shown in figure 3, the front portion of the blades was stationary, and the rear portion was movable.

The stage was tested with the inlet guide vanes set at nine angles. Listed below are the stage designations for each setting angle:

| Stage | Inlet guide vane<br>setting angle,<br>deg from design |
|-------|-------------------------------------------------------|
| 57M2A | 0                                                     |
| 57M2B | -10.0                                                 |
| 57M2C | -17.5                                                 |
| 57M2D | -25.0                                                 |
| 57M2E | 10.0                                                  |
| 57M2F | 17.5                                                  |
| 57M2G | 25.0                                                  |
| 57M2H | 32.5                                                  |
| 57M2I | 42.5                                                  |

## APPARATUS AND PROCEDURE

### Test Facility

The fan stage was tested in the Lewis single-stage compressor test facility, which is diagramed in figure 4. Atmospheric air enters the test facility at a inlet located on the roof of the building, and flows through the flow measuring orifice into the plenum chamber upstream of the test stage. The air then passes through the experimental fan stage into the collector and is exhausted to the facility exhaust system.

### Instrumentation

The fan flow was determined from the measurements on a calibrated thin-plate orifice that was 38.9 centimeters in diameter. The orifice temperature was determined from an average of two Chromel-Constantan thermocouples. Orifice pressures were measured by calibrated transducers.

Radial surveys of the flow were made upstream of the IGV's, between the IGV's and the rotor, between the rotor and the stator, and downstream of the stator (see fig. 1 for axial locations). Photographs of the survey instrumentation are shown in figure 5. At stations 0 and 2 total pressure, total temperature, and flow angle were measured with the combination probe (fig. 5(a)), and the static pressure was measured with an 18° wedge probe (fig. 5(b)). At stations 1 and 3 total pressure and total temperature were measured with the nine-element radial rake (figs. 5(c) and (d)). The static pressure and flow angle were determined from the wedge probe. Each probe was positioned with a null-balancing stream-direction-sensitive control system that automatically aligned the probe to the direction of flow. At station 3 the rakes were set straight ahead. At station 1 the rakes were set to match the IGV angle. The thermocouples were Chromel-Constantan for both the combination probe and the rake.

Inner- and outer-wall static-pressure taps were located at approximately the same axial stations as the survey instrumentation. The circumferential locations of the survey instrumentation along with the inner- and outer-wall static-pressure taps are shown in figure 6.

An electronic speed counter, in conjunction with a magnetic pickup, was used to measure rotative speed (rpm).

The estimated errors of the data based on inherent accuracies of the instrumentation and recording system are as follows:

|                               |      |
|-------------------------------|------|
| Airflow, kg/sec . . . . .     | ±0.3 |
| Rotative speed, rpm . . . . . | ±30  |
| Flow angle, deg . . . . .     | ±1.0 |

|                                                            |       |
|------------------------------------------------------------|-------|
| Temperature, K . . . . .                                   | ±0.6  |
| Rotor-inlet total pressure, N/cm <sup>2</sup> . . . . .    | ±0.04 |
| Rotor-outlet total pressure, N/cm <sup>2</sup> . . . . .   | ±0.10 |
| Stator-outlet total pressure, N/cm <sup>2</sup> . . . . .  | ±0.10 |
| Rotor-inlet static pressure, N/cm <sup>2</sup> . . . . .   | ±0.04 |
| Rotor-outlet static pressure, N/cm <sup>2</sup> . . . . .  | ±0.10 |
| Stator-outlet static pressure, N/cm <sup>2</sup> . . . . . | ±0.10 |
| IGV inlet total pressure, N/cm <sup>2</sup> . . . . .      | ±0.01 |
| IGV inlet static pressure, N/cm <sup>2</sup> . . . . .     | ±0.04 |

### Test Procedure

The stage survey data for each configuration were taken over a range of speeds from 60 to 120 percent of design speed and a range of flows from maximum to near-stall conditions. The data were recorded at nine radial positions for each speed and weight flow.

The combination probes at stations 0 and 2 and the wedge probes at all stations were traversed radially at the same time the nine-element rakes at stations 1 and 3 were traversed circumferentially. The wedge probes were set at midgap because previous studies showed that the static pressure across the stator gap was constant. The probes and rakes were set at their initial position and values of pressure, temperature, and flow angle were recorded. The instruments are then traversed to their next scheduled position, and data were again recorded. When the rakes are at their last circumferential position, the probes are at their last radial position.

### Calculation Procedure

Measured values of total pressure, static pressure, and total temperature were corrected for Mach number and streamline slope. These corrections were based on an average calibration for the type of instrument used. Orifice airflow, rotative speed, static and total pressures, and total temperatures were all corrected to standard-day conditions based on the IGV inlet condition.

For the data reduction program the circumferential distributions of static pressure and flow angle downstream of the inlet guide vane (station 1) and stator (station 3) were assumed to be constant for each radial position and equal to the measured midgap values. The nine values of total temperature were mass-averaged to obtain the stator-outlet temperature. The nine values of total pressure were converted to their enthalpy equivalents and then mass averaged.

To obtain the overall performance, the radial values of total temperature were mass averaged, and the values of total pressure were converted to their enthalpy equivalent and then mass averaged as before.

The sea-level static thrust is composed of both the momentum thrust and the pressure thrust. The momentum thrust is a product of the flow rate and the outlet velocity. The pressure thrust consists of a product of the outlet area and the difference between outlet static pressure and inlet total pressure. The symbols and equations are defined in appendixes A and B.

The weight flow at stall was obtained in the following manner: during operation at the near-stall condition, the collector valve was slowly closed in small increments. At each increment the air flow was obtained. The air flow obtained just before stall occurred is defined as the stall air flow. The pressure ratio at stall was obtained by extrapolating the total pressure obtained from the survey data to the stall air flow.

## RESULTS AND DISCUSSION

The results from this investigation are presented in three sections. The overall performance of the rotor and stage for the design inlet guide vane angle are presented first. (The rotor is the same as that presented in ref. 8, but the blades are set at  $6^\circ$  closed.) The effects of vane angle on the overall performance are then presented. Finally, the effects of vane angle on calculated static thrust are discussed. The overall performances for all nine inlet guide vane angles are presented in tables I to IX.

### Performance with IGV at Design Angle

The overall performance for the rotor and stage are presented in figures 7 and 8, respectively. Pressure ratio and adiabatic efficiency are presented at several flows for speeds of 60, 70, 80, 90, 100, 110, and 120 percent of design. The stall line is also shown for the overall stage performance (fig. 8).

At design speed the rotor had a peak efficiency of 0.905. It occurred at a flow of 24.06 kilograms per second and a pressure ratio of 1.361. The stage peak efficiency of 0.892 occurred at a pressure ratio of 1.322 and a flow of 25.31 kilograms per second. The stall margin was 20 percent based on flow and pressure ratio at stall and peak efficiency.

## Performance Over Range of IGV Setting Angles

Performance curves for the inlet guide vanes set at nine vane setting angles for the 100 and 120 percent of design speeds are shown in figure 9. The stall lines are shown in each figure. The operating line, which passes through the design-speed peak-efficiency point at the  $0^\circ$  vane angle, was obtained by setting a constant throttle valve position and varying the IGV setting angle during tests.

At both the 100 and 120 percent of design speeds, the pressure ratio and flow increase as the inlet guide vane setting angle is changed from  $42.5^\circ$  to  $-17.5^\circ$ . However, a change in the flow characteristics is apparent as the setting angle is further changed to  $-25^\circ$ . At design speed the flow-pressure ratio curve for  $-25^\circ$  is essentially the same as that for  $-17.5^\circ$  except near the stall line. The data presented were corrected to standard-day conditions at the IGV inlet. Had the data been corrected to rotor-inlet conditions, the flow-pressure ratio curve for  $-25^\circ$  would not have been the same as that for  $-17.5^\circ$ . At a setting angle of  $-25^\circ$  the pressure losses across the IGV are considerably greater than those at  $-17.5^\circ$ . For equivalent IGV inlet flows, the rotor will be operating at a higher corrected airflow at an angle of  $-25^\circ$  than at  $-17.5^\circ$ .

At 120 percent design speed the flow-pressure ratio curve for  $-25^\circ$  has dropped and is between those at the  $0^\circ$  and  $-10^\circ$  angles. Preliminary survey data at 120 percent design speed (not presented in this report) indicate that the rotor tip element is choked even at a setting angle of  $0^\circ$ . Turning the inlet guide vanes to more negative angles caused this choked region to move further down the rotor blades.

There is a considerable variation in peak efficiency over the range of vane setting angles. At  $42.5^\circ$  the design speed peak efficiency is 0.676. It continues to increase to a maximum of 0.892 at  $0^\circ$  and then decreases to 0.795 at  $-25^\circ$ . There is a similar change in peak efficiency at 120 percent of design speed; however, the maximum value occurs at an angle of  $10^\circ$ .

Based on the operating line presented, the useful range of inlet-guide-vane setting angle is limited: At the high negative angles, the stage choked; at the high positive angles, the stage stalled.

## Calculated Thrust

The primary purpose of the variable inlet guide vane in this fan stage is to provide thrust modulation capability at constant blade speed. The effect of vane-angle variation on the calculated static thrust is presented in figure 10. Maximum calculated static thrust and operating line static thrust are presented for both the 100 and 120 percent of design speeds.

At 100 percent of design speed (fig. 10(a)) the operating-line static thrust is nearly equal to maximum values except at the higher negative vane setting angles. At 120 percent of design speed the differences are more significant over the setting angle range. At design speed the operating line calculated static thrust varied from 3900 to 6500 newtons, which corresponds to 68 to 114 percent of that obtained at  $0^\circ$  as the inlet guide vane angle was changed from  $32.5^\circ$  to  $-17.5^\circ$ . The lower limit was due to the operating line crossing the stall line and the upper limit was set by choking. In the application of this stage in an engine, a variable area exit nozzle would probably be required to achieve a wider range of thrust. At the more negative angles, more thrust could be realized by reducing the area (and flow); while at the more positive angles, increasing the area would move the operating line away from stall and would allow for further reductions in thrust.

## SUMMARY OF RESULTS

The overall performance of a fan stage suitable for vertical-lift aircraft and incorporating variable inlet guide vanes was determined for nine vane setting angles. Data were obtained over the stable flow range at rotative speeds from 60 to 120 percent of design. The vane angle was varied from  $42.5^\circ$  to  $-25^\circ$ . The following were the principal results of the investigation:

1. At the design speed and the design inlet guide vane angle, the stage had a peak efficiency of 0.892 at a pressure ratio of 1.322 and a flow of 25.31 kilograms per second. The stall margin based on peak efficiency and stall was 20 percent.
2. Based on an operating line passing through the peak efficient point at the design vane setting angle, the useful operating range of the stage at design speed is limited by stall at the high positive setting angles ( $32.5^\circ$ ) and by choke at high negative setting angles ( $-17.5^\circ$ ).
3. At design speed the calculated static thrust along an operating line varied from 68 to 114 percent of that obtained at a vane angle of  $0^\circ$  as the inlet guide vanes were changed from  $32.5^\circ$  to  $-17.5^\circ$ .

Lewis Research Center,  
National Aeronautics and Space Administration,  
Cleveland, Ohio, May 9, 1979,  
505-04.

# APPENDIX A

## SYMBOLS

|          |                                                                                          |
|----------|------------------------------------------------------------------------------------------|
| A        | area, $m^2$                                                                              |
| $A_{an}$ | annulus area at inlet guide vane leading edge, $m^2$                                     |
| $A_f$    | frontal area at inlet guide vane leading edge, $m^2$                                     |
| $C_p$    | specific heat at constant pressure, 1004 J/kg K                                          |
| N        | rotative speed, rpm                                                                      |
| P        | total pressure, $N/cm^2$                                                                 |
| p        | static pressure, $N/cm^2$                                                                |
| SM       | stall margin                                                                             |
| T        | total temperature, K                                                                     |
| U        | wheel speed, m/sec                                                                       |
| V        | air speed, m/sec                                                                         |
| W        | airflow, kg/sec                                                                          |
| $\gamma$ | ratio of specific heats                                                                  |
| $\delta$ | ratio of inlet guide vane inlet total pressure to standard pressure of<br>10.13 $N/cm^2$ |
| $\eta$   | efficiency                                                                               |
| $\theta$ | ratio of inlet guide vane inlet total temperature to standard temperature<br>at 288.2 K  |
| $\rho$   | density, kg/sec                                                                          |

### Subscripts:

|          |                      |
|----------|----------------------|
| ad       | adiabatic            |
| LE       | blade leading edge   |
| mom      | momentum-rise        |
| TE       | blade trailing edge  |
| z        | axial direction      |
| $\theta$ | tangential direction |

Definitions and Units Used in Tables:

|                |                            |
|----------------|----------------------------|
| AREA           | area, m <sup>2</sup>       |
| AIRFLOW        | equivalent airflow, kg/sec |
| ROTATIVE SPEED | rotative speed, rpm        |

## APPENDIX B

### EQUATIONS

Adiabatic (temperature rise) efficiency -

$$\eta_{ad} = \frac{\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/\gamma} - 1}{\frac{T_{TE}}{T_{LE}} - 1} \quad (B1)$$

Momentum-rise efficiency -

$$\eta_{mom} = \frac{\left(\frac{P_{TE}}{P_{LE}}\right)^{(\gamma-1)/\gamma} - 1}{\frac{(UV_{\theta})_{TE} - (UV_{\theta})_{LE}}{T_{LE} C_p}} \quad (B2)$$

Equivalent airflow -

$$\frac{w\sqrt{\theta}}{\delta} \quad (B3)$$

Equivalent rotative speed -

$$\frac{N}{\sqrt{\theta}} \quad (B4)$$

Airflow per unit annulus area -

$$\frac{\left(\frac{w\sqrt{\theta}}{\delta}\right)}{A_{an}} \quad (B5)$$

Airflow per unit frontal area -

$$\frac{\left( \frac{W\sqrt{\theta}}{\delta} \right)}{A_f} \quad (B6)$$

Head-rise coefficient -

$$\frac{C_{p_{TE}}}{U_{tip}^2} \left[ \left( \frac{P_{TE}}{P_{LE}} \right)^{(\gamma-1)/\gamma} - 1 \right] \quad (B7)$$

Flow coefficient -

$$\left( \frac{V_z}{U_{tip}} \right)_{LE} \quad (B8)$$

Stall margin -

$$SM = \left[ \frac{\left( \frac{P_{TE}}{P_{LE}} \right)_{stall} \times \left( \frac{W\sqrt{\theta}}{\delta} \right)_{ref}}{\left( \frac{P_{TE}}{P_{LE}} \right)_{ref} \times \left( \frac{W\sqrt{\theta}}{\delta} \right)_{stall}} - 1 \right] \times 100 \quad (B9)$$

Static thrust -

$$\rho V_z^2 A_{TE} + (p_{TE} - p_{LE}) A_{TE} \quad (B10)$$

## REFERENCES

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TABLE I. - OVERALL PERFORMANCE OF STAGE 57M2A

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0461    | 0460    | 0459    | 0458    | 0457    |
| ICV TOTAL PRESSURE RATIO       | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL PRESSURE RATIO     | 1.587   | 1.529   | 1.457   | 1.367   | 1.310   |
| STATOR TOTAL PRESSURE RATIO    | 0.981   | 0.995   | 0.991   | 0.980   | 0.967   |
| ICV TOTAL TEMPERATURE RATIO    | 1.000   | 1.000   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.166   | 1.156   | 1.143   | 1.125   | 1.116   |
| STATOR TOTAL TEMPERATURE RATIO | 0.995   | 0.995   | 0.995   | 0.996   | 0.995   |
| ROTOR ADIABATIC EFFICIENCY     | 0.849   | 0.826   | 0.796   | 0.746   | 0.688   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.894   | 0.876   | 0.832   | 0.765   | 0.718   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.300   | 0.304   | 0.304   | 0.298   | 0.213   |
| FLOW COEFFICIENT               | 0.371   | 0.395   | 0.407   | 0.409   | 0.410   |
| AIRFLOW PER UNIT FRONTAL AREA  | 133.33  | 140.60  | 144.42  | 145.07  | 145.23  |
| AIRFLOW PER UNIT ANNULUS AREA  | 145.67  | 153.61  | 157.79  | 158.50  | 158.67  |
| AIRFLOW AT ORIFICE             | 27.02   | 28.50   | 29.27   | 29.40   | 29.44   |
| AIRFLOW AT ICV INLET           | 27.00   | 28.55   | 29.23   | 29.38   | 29.39   |
| AIRFLOW AT ROTOR INLET         | 27.11   | 28.66   | 29.31   | 29.41   | 29.45   |
| AIRFLOW AT ROTOR OUTLET        | 25.86   | 27.54   | 28.58   | 28.83   | 29.06   |
| AIRFLOW AT STATOR OUTLET       | 27.27   | 28.76   | 29.23   | 28.86   | 29.09   |
| ROTATIVE SPEED                 | 13079.7 | 13141.7 | 13133.1 | 13122.0 | 13097.1 |
| PERCENT OF DESIGN SPEED        | 120.2   | 120.7   | 120.6   | 120.5   | 120.3   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.555   | 1.520   | 1.442   | 1.338   | 1.265   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.160   | 1.149   | 1.136   | 1.121   | 1.110   |
| STAGE ADIABATIC EFFICIENCY     | 0.842   | 0.851   | 0.811   | 0.718   | 0.634   |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0456    | 0454    | 0453    | 0451    | 0450    |
| ICV TOTAL PRESSURE RATIO       | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL PRESSURE RATIO     | 1.489   | 1.489   | 1.443   | 1.323   | 1.266   |
| STATOR TOTAL PRESSURE RATIO    | 0.980   | 0.989   | 0.990   | 0.984   | 0.970   |
| ICV TOTAL TEMPERATURE RATIO    | 1.000   | 1.000   | 1.000   | 1.000   | 1.000   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.138   | 1.130   | 1.123   | 1.105   | 1.097   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.993   | 0.995   | 0.997   | 0.995   |
| ROTOR ADIABATIC EFFICIENCY     | 0.876   | 0.863   | 0.844   | 0.791   | 0.741   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.920   | 0.931   | 0.902   | 0.810   | 0.752   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.390   | 0.364   | 0.332   | 0.263   | 0.219   |
| FLOW COEFFICIENT               | 0.362   | 0.399   | 0.416   | 0.427   | 0.429   |
| AIRFLOW PER UNIT FRONTAL AREA  | 120.99  | 131.09  | 136.19  | 139.69  | 139.84  |
| AIRFLOW PER UNIT ANNULUS AREA  | 132.19  | 143.23  | 148.80  | 152.62  | 152.79  |
| AIRFLOW AT ORIFICE             | 24.52   | 26.57   | 27.60   | 28.31   | 28.34   |
| AIRFLOW AT ICV INLET           | 24.49   | 26.58   | 27.61   | 28.22   | 28.27   |
| AIRFLOW AT ROTOR INLET         | 24.55   | 26.63   | 27.62   | 28.28   | 28.33   |
| AIRFLOW AT ROTOR OUTLET        | 23.74   | 25.81   | 26.92   | 27.63   | 27.97   |
| AIRFLOW AT STATOR OUTLET       | 24.44   | 26.34   | 27.24   | 27.56   | 27.71   |
| ROTATIVE SPEED                 | 11987.7 | 11962.0 | 11973.7 | 11968.9 | 11956.4 |
| PERCENT OF DESIGN SPEED        | 110.1   | 109.9   | 110.0   | 109.9   | 109.8   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.458   | 1.435   | 1.396   | 1.300   | 1.227   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.133   | 1.123   | 1.117   | 1.102   | 1.091   |
| STAGE ADIABATIC EFFICIENCY     | 0.858   | 0.885   | 0.857   | 0.765   | 0.662   |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0449    | 0448    | 0447    | 0446    | 0445    |
| ICV TOTAL PRESSURE RATIO       | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL PRESSURE RATIO     | 1.380   | 1.361   | 1.338   | 1.302   | 1.226   |
| STATOR TOTAL PRESSURE RATIO    | 0.986   | 0.989   | 0.989   | 0.982   | 0.972   |
| ICV TOTAL TEMPERATURE RATIO    | 1.000   | 1.000   | 0.999   | 0.999   | 1.000   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.111   | 1.104   | 1.098   | 1.090   | 1.079   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.996   | 0.996   | 0.996   | 0.996   |
| ROTOR ADIABATIC EFFICIENCY     | 0.869   | 0.885   | 0.883   | 0.874   | 0.761   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.920   | 0.945   | 0.940   | 0.905   | 0.791   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.371   | 0.353   | 0.330   | 0.295   | 0.223   |
| FLOW COEFFICIENT               | 0.358   | 0.392   | 0.415   | 0.445   | 0.453   |
| AIRFLOW PER UNIT FRONTAL AREA  | 109.70  | 117.65  | 124.87  | 132.90  | 135.60  |
| AIRFLOW PER UNIT ANNULUS AREA  | 119.85  | 129.63  | 136.44  | 145.20  | 148.15  |
| AIRFLOW AT ORIFICE             | 22.23   | 24.05   | 25.31   | 26.94   | 27.48   |
| AIRFLOW AT ICV INLET           | 22.24   | 24.06   | 25.32   | 26.94   | 27.40   |
| AIRFLOW AT ROTOR INLET         | 22.22   | 24.06   | 25.35   | 26.95   | 27.43   |
| AIRFLOW AT ROTOR OUTLET        | 21.52   | 23.52   | 24.83   | 26.50   | 26.94   |
| AIRFLOW AT STATOR OUTLET       | 21.96   | 23.62   | 24.74   | 26.16   | 26.67   |
| ROTATIVE SPEED                 | 10868.6 | 10858.5 | 10863.8 | 10876.6 | 10893.9 |
| PERCENT OF DESIGN SPEED        | 99.8    | 99.7    | 99.8    | 99.9    | 100.1   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.359   | 1.344   | 1.322   | 1.277   | 1.191   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.106   | 1.099   | 1.093   | 1.085   | 1.074   |
| STAGE ADIABATIC EFFICIENCY     | 0.862   | 0.891   | 0.892   | 0.851   | 0.693   |

TABLE I. - Continued, OVERALL PERFORMANCE OF STAGE 57M2A

## (d) 90 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0466   | 0465   | 0464   | 0463   | 0462   |
| IGV TOTAL PRESSURE RATIO       | 0.999  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.295  | 1.278  | 1.256  | 1.235  | 1.189  |
| STATOR TOTAL PRESSURE RATIO    | 0.989  | 0.992  | 0.992  | 0.988  | 0.976  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.089  | 1.082  | 1.075  | 1.069  | 1.063  |
| STATOR TOTAL TEMPERATURE RATIO | 0.997  | 0.998  | 0.998  | 0.998  | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.865  | 0.888  | 0.899  | 0.898  | 0.810  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.924  | 0.945  | 0.952  | 0.939  | 0.854  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.360  | 0.339  | 0.312  | 0.286  | 0.232  |
| FLOW COEFFICIENT               | 0.347  | 0.383  | 0.417  | 0.446  | 0.478  |
| AIRFLOW PER UNIT FRONTAL AREA  | 96.44  | 105.44 | 114.03 | 121.13 | 128.83 |
| AIRFLOW PER UNIT ANNULUS AREA  | 105.37 | 115.20 | 124.58 | 132.34 | 140.75 |
| AIRFLOW AT ORIFICE             | 19.55  | 21.37  | 23.11  | 24.55  | 26.11  |
| AIRFLOW AT IGV INLET           | 19.57  | 21.36  | 23.11  | 24.53  | 26.03  |
| AIRFLOW AT ROTOR INLET         | 19.54  | 21.36  | 23.12  | 24.53  | 26.07  |
| AIRFLOW AT ROTOR OUTLET        | 19.03  | 20.82  | 22.67  | 24.09  | 25.48  |
| AIRFLOW AT STATOR OUTLET       | 19.38  | 21.01  | 22.61  | 23.90  | 25.35  |
| ROTATIVE SPEED                 | 9749.3 | 9735.7 | 9740.1 | 9747.6 | 9736.0 |
| PERCENT OF DESIGN SPEED        | 89.6   | 89.4   | 89.5   | 89.5   | 89.4   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.280 | 1.268 | 1.245 | 1.218 | 1.159 |
| STAGE TOTAL TEMPERATURE RATIO | 1.085 | 1.079 | 1.072 | 1.066 | 1.058 |
| STAGE ADIABATIC EFFICIENCY    | 0.859 | 0.893 | 0.900 | 0.876 | 0.742 |

## (e) 80 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0471   | 0470   | 0469   | 0468   | 0467   |
| IGV TOTAL PRESSURE RATIO       | 1.000  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.228  | 1.214  | 1.194  | 1.177  | 1.153  |
| STATOR TOTAL PRESSURE RATIO    | 0.992  | 0.992  | 0.990  | 0.984  | 0.976  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.070  | 1.063  | 1.057  | 1.053  | 1.048  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.998  | 0.998  | 0.997  | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.869  | 0.900  | 0.907  | 0.903  | 0.859  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.930  | 0.963  | 0.963  | 0.954  | 0.910  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.349  | 0.327  | 0.327  | 0.324  | 0.310  |
| FLOW COEFFICIENT               | 0.345  | 0.388  | 0.425  | 0.458  | 0.490  |
| AIRFLOW PER UNIT FRONTAL AREA  | 86.30  | 96.28  | 104.71 | 111.95 | 119.04 |
| AIRFLOW PER UNIT ANNULUS AREA  | 94.29  | 105.19 | 114.40 | 122.31 | 130.05 |
| AIRFLOW AT ORIFICE             | 17.49  | 19.52  | 21.22  | 22.69  | 24.13  |
| AIRFLOW AT IGV INLET           | 17.47  | 19.51  | 21.22  | 22.67  | 24.08  |
| AIRFLOW AT ROTOR INLET         | 17.46  | 19.49  | 21.19  | 22.66  | 24.08  |
| AIRFLOW AT ROTOR OUTLET        | 16.92  | 19.12  | 20.87  | 22.39  | 23.67  |
| AIRFLOW AT STATOR OUTLET       | 17.19  | 18.97  | 20.54  | 21.83  | 23.23  |
| ROTATIVE SPEED                 | 8701.3 | 8707.3 | 8706.8 | 8689.7 | 8691.4 |
| PERCENT OF DESIGN SPEED        | 79.9   | 80.0   | 80.0   | 79.8   | 79.8   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.217 | 1.204 | 1.182 | 1.157 | 1.124 |
| STAGE TOTAL TEMPERATURE RATIO | 1.067 | 1.061 | 1.055 | 1.049 | 1.044 |
| STAGE ADIABATIC EFFICIENCY    | 0.866 | 0.893 | 0.893 | 0.862 | 0.766 |

## (f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0477   | 0476   | 0475   | 0474   | 0473   |
| IGV TOTAL PRESSURE RATIO       | 1.000  | 1.000  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.169  | 1.159  | 1.143  | 1.129  | 1.111  |
| STATOR TOTAL PRESSURE RATIO    | 0.994  | 0.995  | 0.991  | 0.987  | 0.981  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 1.000  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.052  | 1.048  | 1.043  | 1.039  | 1.036  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.999  | 0.998  | 0.998  | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.875  | 0.901  | 0.916  | 0.901  | 0.858  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.941  | 0.970  | 0.979  | 0.963  | 0.927  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.339  | 0.318  | 0.287  | 0.259  | 0.224  |
| FLOW COEFFICIENT               | 0.343  | 0.383  | 0.429  | 0.464  | 0.500  |
| AIRFLOW PER UNIT FRONTAL AREA  | 75.35  | 83.83  | 93.17  | 100.18 | 107.60 |
| AIRFLOW PER UNIT ANNULUS AREA  | 82.33  | 91.59  | 101.79 | 109.46 | 117.56 |
| AIRFLOW AT ORIFICE             | 15.27  | 16.99  | 18.88  | 20.31  | 21.81  |
| AIRFLOW AT IGV INLET           | 15.31  | 16.99  | 18.91  | 20.29  | 21.79  |
| AIRFLOW AT ROTOR INLET         | 15.28  | 16.98  | 18.88  | 20.28  | 21.77  |
| AIRFLOW AT ROTOR OUTLET        | 14.82  | 16.61  | 18.66  | 19.96  | 21.28  |
| AIRFLOW AT STATOR OUTLET       | 15.00  | 16.52  | 18.28  | 19.52  | 21.00  |
| ROTATIVE SPEED                 | 7611.1 | 7608.9 | 7603.2 | 7600.8 | 7607.8 |
| PERCENT OF DESIGN SPEED        | 69.9   | 69.9   | 69.8   | 69.8   | 69.9   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.161 | 1.152 | 1.132 | 1.113 | 1.090 |
| STAGE TOTAL TEMPERATURE RATIO | 1.050 | 1.046 | 1.040 | 1.037 | 1.033 |
| STAGE ADIABATIC EFFICIENCY    | 0.866 | 0.895 | 0.892 | 0.850 | 0.748 |

TABLE I. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2A

(g) 60 Percent of design speed

|                                |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|
| READING NUMBER                 | 0481   | 0480   | 0479   | 0478   |
| IGV TOTAL PRESSURE RATIO       | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.122  | 1.109  | 1.095  | 1.078  |
| STATOR TOTAL PRESSURE RATIO    | 0.995  | 0.995  | 0.991  | 0.984  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.038  | 1.033  | 1.029  | 1.025  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.877  | 0.914  | 0.915  | 0.867  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.248  | 1.000  | 0.993  | 0.955  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.332  | 0.298  | 0.259  | 0.213  |
| FLOW COEFFICIENT               | 0.336  | 0.404  | 0.457  | 0.513  |
| AIRFLOW PER UNIT FRONTAL AREA  | 63.68  | 76.15  | 85.79  | 95.35  |
| AIRFLOW PER UNIT ANNULUS AREA  | 69.57  | 83.20  | 93.73  | 104.17 |
| AIRFLOW AT ORIFICE             | 12.91  | 15.43  | 17.39  | 19.33  |
| AIRFLOW AT IGV INLET           | 12.94  | 15.46  | 17.40  | 19.31  |
| AIRFLOW AT Rotor INLET         | 12.91  | 15.42  | 17.37  | 19.27  |
| AIRFLOW AT Rotor OUTLET        | 12.50  | 15.23  | 17.11  | 18.84  |
| AIRFLOW AT STATOR OUTLET       | 12.67  | 14.96  | 16.73  | 18.59  |
| ROTATIVE SPEED                 | 6534.2 | 6522.9 | 6534.0 | 6514.1 |
| PERCENT OF DESIGN SPEED        | 60.0   | 59.9   | 60.0   | 59.8   |
| COMPRESSOR PERFORMANCE         |        |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.116  | 1.103  | 1.084  | 1.060  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.037  | 1.031  | 1.027  | 1.023  |
| STAGE ADIABATIC EFFICIENCY     | 0.869  | 0.902  | 0.859  | 0.714  |

TABLE II. - OVERALL PERFORMANCE OF STAGE 57M2B

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0504    | 0502    | 0503    | 0501    | 0500    | 0499    |
| IGV TOTAL PRESSURE RATIO       | 0.998   | 0.998   | 0.998   | 0.998   | 0.998   | 0.998   |
| ROTOR TOTAL PRESSURE RATIO     | 1.582   | 1.572   | 1.557   | 1.489   | 1.419   | 1.350   |
| STATOR TOTAL PRESSURE RATIO    | 0.990   | 0.991   | 0.987   | 0.981   | 0.970   | 0.943   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 1.000   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.173   | 1.170   | 1.167   | 1.156   | 1.144   | 1.134   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.996   | 0.996   | 0.996   | 0.995   | 0.993   |
| ROTOR ADIABATIC EFFICIENCY     | 0.811   | 0.810   | 0.807   | 0.773   | 0.731   | 0.667   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.837   | 0.838   | 0.840   | 0.796   | 0.748   | 0.703   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.394   | 0.387   | 0.377   | 0.332   | 0.288   | 0.243   |
| FLOW COEFFICIENT               | 0.396   | 0.404   | 0.416   | 0.421   | 0.423   | 0.424   |
| AIRFLOW PER UNIT FRONTAL AREA  | 140.12  | 142.54  | 146.45  | 148.33  | 148.66  | 148.94  |
| AIRFLOW PER UNIT ANNULUS AREA  | 153.09  | 155.73  | 160.00  | 162.06  | 162.42  | 162.72  |
| AIRFLOW AT ORIFICE             | 28.40   | 28.89   | 29.68   | 30.06   | 30.13   | 30.19   |
| AIRFLOW AT IGV INLET           | 28.45   | 28.91   | 29.66   | 29.96   | 30.04   | 30.10   |
| AIRFLOW AT ROTOR INLET         | 28.68   | 29.16   | 29.89   | 30.17   | 30.25   | 30.30   |
| AIRFLOW AT ROTOR OUTLET        | 27.85   | 28.43   | 29.55   | 29.89   | 30.07   | 30.39   |
| AIRFLOW AT STATOR OUTLET       | 28.96   | 29.38   | 29.80   | 29.47   | 29.17   | 30.39   |
| ROTATIVE SPEED                 | 13057.6 | 13068.8 | 13077.2 | 13080.0 | 13061.5 | 13059.4 |
| PERCENT OF DESIGN SPEED        | 119.9   | 120.1   | 120.1   | 120.2   | 120.0   | 120.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.543 | 1.555 | 1.533 | 1.458 | 1.374 | 1.271 |
| STAGE TOTAL TEMPERATURE RATIO | 1.168 | 1.165 | 1.162 | 1.150 | 1.139 | 1.125 |
| STAGE ADIABATIC EFFICIENCY    | 0.811 | 0.813 | 0.802 | 0.757 | 0.698 | 0.565 |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0498    | 0497    | 0496    | 0495    | 0494    |
| IGV TOTAL PRESSURE RATIO       | 0.999   | 0.998   | 0.998   | 0.998   | 0.998   |
| ROTOR TOTAL PRESSURE RATIO     | 1.535   | 1.504   | 1.444   | 1.364   | 1.317   |
| STATOR TOTAL PRESSURE RATIO    | 0.980   | 0.989   | 0.982   | 0.969   | 0.945   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 1.000   | 1.000   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.151   | 1.145   | 1.132   | 1.121   | 1.113   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.996   | 0.997   | 0.996   | 0.995   |
| ROTOR ADIABATIC EFFICIENCY     | 0.865   | 0.855   | 0.835   | 0.768   | 0.728   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.893   | 0.889   | 0.856   | 0.796   | 0.753   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.427   | 0.404   | 0.357   | 0.297   | 0.260   |
| FLOW COEFFICIENT               | 0.381   | 0.416   | 0.438   | 0.445   | 0.446   |
| AIRFLOW PER UNIT FRONTAL AREA  | 126.57  | 136.15  | 142.47  | 144.44  | 144.82  |
| AIRFLOW PER UNIT ANNULUS AREA  | 138.29  | 148.74  | 155.46  | 157.81  | 158.22  |
| AIRFLOW AT ORIFICE             | 25.65   | 27.59   | 28.88   | 29.28   | 29.35   |
| AIRFLOW AT IGV INLET           | 25.62   | 27.57   | 28.83   | 29.17   | 29.25   |
| AIRFLOW AT ROTOR INLET         | 25.83   | 27.77   | 29.01   | 29.36   | 29.44   |
| AIRFLOW AT ROTOR OUTLET        | 25.44   | 27.14   | 28.61   | 28.97   | 29.74   |
| AIRFLOW AT STATOR OUTLET       | 25.63   | 27.57   | 27.97   | 28.13   | 29.10   |
| ROTATIVE SPEED                 | 11980.8 | 11964.4 | 11987.6 | 11965.0 | 11979.2 |
| PERCENT OF DESIGN SPEED        | 110.1   | 109.9   | 110.1   | 109.9   | 110.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.502 | 1.485 | 1.415 | 1.319 | 1.243 |
| STAGE TOTAL TEMPERATURE RATIO | 1.146 | 1.139 | 1.128 | 1.115 | 1.106 |
| STAGE ADIABATIC EFFICIENCY    | 0.841 | 0.859 | 0.812 | 0.718 | 0.608 |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0492    | 0491    | 0490    | 0489    | 0488    |
| IGV TOTAL PRESSURE RATIO       | 0.999   | 0.999   | 0.998   | 0.998   | 0.998   |
| ROTOR TOTAL PRESSURE RATIO     | 1.413   | 1.412   | 1.383   | 1.322   | 1.271   |
| STATOR TOTAL PRESSURE RATIO    | 0.989   | 0.987   | 0.985   | 0.976   | 0.951   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.119   | 1.116   | 1.109   | 1.101   | 1.093   |
| STATOR TOTAL TEMPERATURE RATIO | 0.998   | 0.997   | 0.998   | 0.997   | 0.996   |
| ROTOR ADIABATIC EFFICIENCY     | 0.873   | 0.896   | 0.894   | 0.819   | 0.762   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.898   | 0.930   | 0.918   | 0.846   | 0.778   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.400   | 0.398   | 0.371   | 0.315   | 0.266   |
| FLOW COEFFICIENT               | 0.379   | 0.416   | 0.445   | 0.466   | 0.469   |
| AIRFLOW PER UNIT FRONTAL AREA  | 115.71  | 125.67  | 133.34  | 138.66  | 139.60  |
| AIRFLOW PER UNIT ANNULUS AREA  | 126.42  | 137.31  | 145.66  | 151.49  | 152.51  |
| AIRFLOW AT ORIFICE             | 23.45   | 25.47   | 27.03   | 28.10   | 28.29   |
| AIRFLOW AT IGV INLET           | 23.43   | 25.42   | 26.97   | 28.03   | 28.21   |
| AIRFLOW AT ROTOR INLET         | 23.53   | 25.57   | 27.13   | 28.19   | 28.34   |
| AIRFLOW AT ROTOR OUTLET        | 22.91   | 25.23   | 26.76   | 27.64   | 28.47   |
| AIRFLOW AT STATOR OUTLET       | 23.16   | 25.04   | 26.15   | 27.04   | 27.64   |
| ROTATIVE SPEED                 | 10898.7 | 10895.4 | 10898.2 | 10886.0 | 10900.9 |
| PERCENT OF DESIGN SPEED        | 100.1   | 100.1   | 100.1   | 100.0   | 100.1   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.396 | 1.392 | 1.360 | 1.298 | 1.206 |
| STAGE TOTAL TEMPERATURE RATIO | 1.117 | 1.112 | 1.106 | 1.097 | 1.088 |
| STAGE ADIABATIC EFFICIENCY    | 0.857 | 0.886 | 0.866 | 0.771 | 0.624 |

TABLE II. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2B

## (d) 90 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0507   |
| IGV TOTAL PRESSURE RATIO       | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.317  |
| STATOR TOTAL PRESSURE RATIO    | 0.991  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.096  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.854  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.898  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.383  |
| FLOW COEFFICIENT               | 0.364  |
| AIRFLOW PER UNIT FRONTAL AREA  | 101.10 |
| AIRFLOW PER UNIT ANNULUS AREA  | 110.45 |
| AIRFLOW AT ORIFICE             | 20.49  |
| AIRFLOW AT IGV INLET           | 20.48  |
| AIRFLOW AT ROTOR INLET         | 20.59  |
| AIRFLOW AT ROTOR OUTLET        | 20.11  |
| AIRFLOW AT STATOR OUTLET       | 20.24  |
| ROTATIVE SPEED                 | 9779.5 |
| PERCENT OF DESIGN SPEED        | 89.8   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.304 |
| STAGE TOTAL TEMPERATURE RATIO | 1.093 |
| STAGE ADIABATIC EFFICIENCY    | 0.849 |

## (e) 80 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0508   |
| IGV TOTAL PRESSURE RATIO       | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.246  |
| STATOR TOTAL PRESSURE RATIO    | 0.991  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.075  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.864  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.905  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.374  |
| FLOW COEFFICIENT               | 0.359  |
| AIRFLOW PER UNIT FRONTAL AREA  | 89.77  |
| AIRFLOW PER UNIT ANNULUS AREA  | 98.08  |
| AIRFLOW AT ORIFICE             | 18.20  |
| AIRFLOW AT IGV INLET           | 18.20  |
| AIRFLOW AT ROTOR INLET         | 18.29  |
| AIRFLOW AT ROTOR OUTLET        | 18.00  |
| AIRFLOW AT STATOR OUTLET       | 17.88  |
| ROTATIVE SPEED                 | 8733.8 |
| PERCENT OF DESIGN SPEED        | 80.2   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.234 |
| STAGE TOTAL TEMPERATURE RATIO | 1.073 |
| STAGE ADIABATIC EFFICIENCY    | 0.845 |

## (f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0513   | 0512   | 0511   | 0510   | 0509   |
| IGV TOTAL PRESSURE RATIO       | 0.999  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.161  | 1.173  | 1.160  | 1.150  | 1.139  |
| STATOR TOTAL PRESSURE RATIO    | 0.993  | 0.993  | 0.991  | 0.981  | 0.968  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.056  | 1.052  | 1.049  | 1.046  | 1.043  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | 0.999  | 0.999  | 0.998  | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.870  | 0.895  | 0.892  | 0.892  | 0.882  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.918  | 0.952  | 0.960  | 0.960  | 0.946  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.363  | 0.347  | 0.321  | 0.299  | 0.278  |
| FLOW COEFFICIENT               | 0.363  | 0.405  | 0.448  | 0.488  | 0.525  |
| AIRFLOW PER UNIT FRONTAL AREA  | 79.72  | 88.63  | 97.22  | 105.42 | 112.73 |
| AIRFLOW PER UNIT ANNULUS AREA  | 87.09  | 96.83  | 106.22 | 115.17 | 123.16 |
| AIRFLOW AT ORIFICE             | 16.16  | 17.96  | 19.71  | 21.37  | 22.85  |
| AIRFLOW AT IGV INLET           | 16.15  | 17.93  | 19.71  | 21.31  | 22.79  |
| AIRFLOW AT ROTOR INLET         | 16.24  | 18.03  | 19.80  | 21.42  | 22.87  |
| AIRFLOW AT ROTOR OUTLET        | 15.93  | 17.74  | 19.32  | 21.12  | 22.75  |
| AIRFLOW AT STATOR OUTLET       | 15.78  | 17.28  | 18.95  | 20.34  | 21.96  |
| ROTATIVE SPEED                 | 7614.4 | 7618.1 | 7624.1 | 7620.1 | 7613.7 |
| PERCENT OF DESIGN SPEED        | 69.9   | 70.0   | 70.0   | 70.0   | 69.9   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.172 | 1.164 | 1.149 | 1.127 | 1.102 |
| STAGE TOTAL TEMPERATURE RATIO | 1.054 | 1.051 | 1.047 | 1.043 | 1.041 |
| STAGE ADIABATIC EFFICIENCY    | 0.855 | 0.879 | 0.865 | 0.800 | 0.685 |

## (g) 60 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0514   |
| IGV TOTAL PRESSURE RATIO       | 1.000  |
| ROTOR TOTAL PRESSURE RATIO     | 1.130  |
| STATOR TOTAL PRESSURE RATIO    | 0.995  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.040  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.880  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.926  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.349  |
| FLOW COEFFICIENT               | 0.369  |
| AIRFLOW PER UNIT FRONTAL AREA  | 70.34  |
| AIRFLOW PER UNIT ANNULUS AREA  | 76.85  |
| AIRFLOW AT ORIFICE             | 14.26  |
| AIRFLOW AT IGV INLET           | 14.28  |
| AIRFLOW AT ROTOR INLET         | 14.38  |
| AIRFLOW AT ROTOR OUTLET        | 14.03  |
| AIRFLOW AT STATOR OUTLET       | 15.81  |
| ROTATIVE SPEED                 | 6582.0 |
| PERCENT OF DESIGN SPEED        | 60.5   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.124 |
| STAGE TOTAL TEMPERATURE RATIO | 1.040 |
| STAGE ADIABATIC EFFICIENCY    | 0.860 |

TABLE III. - OVERALL PERFORMANCE OF STAGE 57M2C

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0554    | 0553    | 0552    | 0551    | 0550    |
| IGV TOTAL PRESSURE RATIO       | 0.992   | 0.989   | 0.988   | 0.988   | 0.988   |
| ROTOR TOTAL PRESSURE RATIO     | 1.602   | 1.572   | 1.514   | 1.463   | 1.406   |
| STATOR TOTAL PRESSURE RATIO    | 0.988   | 0.975   | 0.958   | 0.943   | 0.929   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.998   | 0.998   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.187   | 1.178   | 1.169   | 1.159   | 1.148   |
| STATOR TOTAL TEMPERATURE RATIO | 0.994   | 0.996   | 0.993   | 0.993   | 0.994   |
| ROTOR ADIABATIC EFFICIENCY     | 0.770   | 0.775   | 0.747   | 0.720   | 0.693   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.806   | 0.796   | 0.769   | 0.739   | 0.708   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.410   | 0.389   | 0.355   | 0.321   | 0.282   |
| FLOW COEFFICIENT               | 0.401   | 0.424   | 0.427   | 0.428   | 0.429   |
| AIRFLOW PER UNIT FRONTAL AREA  | 142.19  | 148.73  | 149.59  | 150.04  | 150.19  |
| AIRFLOW PER UNIT ANNULUS AREA  | 155.35  | 162.50  | 163.43  | 163.93  | 164.09  |
| AIRFLOW AT ORIFICE             | 28.82   | 30.15   | 30.32   | 30.41   | 30.44   |
| AIRFLOW AT IGV INLET           | 28.78   | 30.11   | 30.21   | 30.28   | 30.33   |
| AIRFLOW AT ROTOR INLET         | 28.95   | 30.12   | 30.25   | 30.33   | 30.36   |
| AIRFLOW AT ROTOR OUTLET        | 28.31   | 30.04   | 30.62   | 31.30   | 31.25   |
| AIRFLOW AT STATOR OUTLET       | 29.16   | 29.62   | 29.17   | 29.25   | 30.54   |
| ROTATIVE SPEED                 | 13062.3 | 13058.9 | 13017.5 | 13018.9 | 13035.4 |
| PERCENT OF DESIGN SPEED        | 120.0   | 120.0   | 119.6   | 119.6   | 119.7   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.570   | 1.515   | 1.433   | 1.364   | 1.291   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.181   | 1.172   | 1.159   | 1.150   | 1.142   |
| STAGE ADIABATIC EFFICIENCY     | 0.761   | 0.733   | 0.682   | 0.620   | 0.532   |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0526    | 0525    | 0524    | 0523    | 0522    |
| IGV TOTAL PRESSURE RATIO       | 0.994   | 0.992   | 0.991   | 0.990   | 0.989   |
| ROTOR TOTAL PRESSURE RATIO     | 1.528   | 1.513   | 1.474   | 1.421   | 1.360   |
| STATOR TOTAL PRESSURE RATIO    | 0.994   | 0.987   | 0.975   | 0.957   | 0.936   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.159   | 1.154   | 1.148   | 1.138   | 1.128   |
| STATOR TOTAL TEMPERATURE RATIO | 0.997   | 0.997   | 0.995   | 0.995   | 0.996   |
| ROTOR ADIABATIC EFFICIENCY     | 0.812   | 0.816   | 0.795   | 0.766   | 0.719   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.849   | 0.847   | 0.829   | 0.800   | 0.759   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.426   | 0.414   | 0.384   | 0.348   | 0.314   |
| FLOW COEFFICIENT               | 0.411   | 0.434   | 0.449   | 0.452   | 0.454   |
| AIRFLOW PER UNIT FRONTAL AREA  | 134.82  | 141.01  | 145.32  | 146.37  | 146.83  |
| AIRFLOW PER UNIT ANNULUS AREA  | 147.29  | 154.06  | 158.77  | 159.91  | 160.42  |
| AIRFLOW AT ORIFICE             | 27.33   | 28.58   | 29.46   | 29.67   | 29.76   |
| AIRFLOW AT IGV INLET           | 27.31   | 28.57   | 29.36   | 29.54   | 29.66   |
| AIRFLOW AT ROTOR INLET         | 27.52   | 28.74   | 29.50   | 29.66   | 29.75   |
| AIRFLOW AT ROTOR OUTLET        | 26.19   | 27.79   | 29.01   | 30.02   | 30.32   |
| AIRFLOW AT STATOR OUTLET       | 27.30   | 28.09   | 28.43   | 28.43   | 30.04   |
| ROTATIVE SPEED                 | 11973.7 | 11971.4 | 11968.3 | 11951.3 | 11964.9 |
| PERCENT OF DESIGN SPEED        | 110.0   | 110.0   | 109.9   | 109.8   | 109.9   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.510   | 1.482   | 1.424   | 1.347   | 1.260   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.155   | 1.149   | 1.141   | 1.131   | 1.122   |
| STAGE ADIABATIC EFFICIENCY     | 0.805   | 0.797   | 0.753   | 0.677   | 0.559   |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0521    | 0520    | 0519    | 0518    | 0517    |
| IGV TOTAL PRESSURE RATIO       | 0.997   | 0.995   | 0.994   | 0.993   | 0.992   |
| ROTOR TOTAL PRESSURE RATIO     | 1.440   | 1.446   | 1.418   | 1.374   | 1.314   |
| STATOR TOTAL PRESSURE RATIO    | 0.987   | 0.990   | 0.988   | 0.968   | 0.946   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 1.000   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.129   | 1.128   | 1.122   | 1.115   | 1.105   |
| STATOR TOTAL TEMPERATURE RATIO | 0.998   | 0.997   | 0.998   | 0.996   | 0.998   |
| ROTOR ADIABATIC EFFICIENCY     | 0.849   | 0.870   | 0.858   | 0.819   | 0.774   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.886   | 0.910   | 0.895   | 0.855   | 0.813   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.429   | 0.434   | 0.407   | 0.363   | 0.310   |
| FLOW COEFFICIENT               | 0.390   | 0.432   | 0.457   | 0.478   | 0.482   |
| AIRFLOW PER UNIT FRONTAL AREA  | 118.56  | 129.57  | 136.38  | 141.41  | 142.51  |
| AIRFLOW PER UNIT ANNULUS AREA  | 129.52  | 141.56  | 149.00  | 154.50  | 155.69  |
| AIRFLOW AT ORIFICE             | 24.03   | 26.26   | 27.64   | 28.66   | 28.88   |
| AIRFLOW AT IGV INLET           | 23.98   | 26.23   | 27.56   | 28.57   | 28.80   |
| AIRFLOW AT ROTOR INLET         | 24.13   | 26.37   | 27.73   | 28.72   | 28.96   |
| AIRFLOW AT ROTOR OUTLET        | 23.71   | 25.58   | 26.88   | 28.32   | 28.99   |
| AIRFLOW AT STATOR OUTLET       | 23.77   | 25.86   | 26.73   | 27.40   | 28.76   |
| ROTATIVE SPEED                 | 10868.8 | 10873.7 | 10876.0 | 10866.4 | 10885.8 |
| PERCENT OF DESIGN SPEED        | 99.8    | 99.9    | 99.9    | 99.8    | 100.0   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.417   | 1.426   | 1.393   | 1.317   | 1.234   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.126   | 1.123   | 1.119   | 1.110   | 1.101   |
| STAGE ADIABATIC EFFICIENCY     | 0.833   | 0.864   | 0.833   | 0.742   | 0.611   |

TABLE III. - Continued. OVERALL PERFORMANCE OF STAGE 57M2C

## (d) 90 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0547   | 0546   | 0545   | 0544   | 0543   |
| IGV TOTAL PRESSURE RATIO       | 0.997  | 0.997  | 0.995  | 0.994  | 0.994  |
| ROTOR TOTAL PRESSURE RATIO     | 1.338  | 1.343  | 1.324  | 1.302  | 1.264  |
| STATOR TOTAL PRESSURE RATIO    | 0.990  | 0.987  | 0.983  | 0.964  | 0.945  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.103  | 1.099  | 1.094  | 1.081  | 1.066  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.998  | 0.998  | 0.997  | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.844  | 0.886  | 0.884  | 0.858  | 0.809  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.882  | 0.921  | 0.931  | 0.900  | 0.860  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.407  | 0.409  | 0.399  | 0.362  | 0.320  |
| FLOW COEFFICIENT               | 0.388  | 0.474  | 0.474  | 0.504  | 0.512  |
| AIRFLOW PER UNIT FRONTAL AREA  | 107.32 | 118.12 | 128.68 | 135.63 | 137.53 |
| AIRFLOW PER UNIT ANNULUS AREA  | 117.26 | 129.05 | 140.59 | 148.19 | 150.26 |
| AIRFLOW AT ORIFICE             | 21.75  | 23.94  | 26.08  | 27.49  | 27.88  |
| AIRFLOW AT IGV INLET           | 21.77  | 23.91  | 26.02  | 27.46  | 27.76  |
| AIRFLOW AT ROTOR INLET         | 21.77  | 23.95  | 26.10  | 27.55  | 27.87  |
| AIRFLOW AT ROTOR OUTLET        | 21.45  | 23.62  | 25.50  | 27.44  | 27.86  |
| AIRFLOW AT STATOR OUTLET       | 21.28  | 23.16  | 24.90  | 26.38  | 27.11  |
| ROTATIVE SPEED                 | 9811.3 | 9834.3 | 9800.5 | 9820.5 | 9792.0 |
| PERCENT OF DESIGN SPEED        | 90.1   | 90.3   | 90.0   | 90.2   | 90.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.321 | 1.321 | 1.295 | 1.248 | 1.188 |
| STAGE TOTAL TEMPERATURE RATIO | 1.099 | 1.096 | 1.091 | 1.087 | 1.082 |
| STAGE ADIABATIC EFFICIENCY    | 0.833 | 0.860 | 0.843 | 0.748 | 0.614 |

## (e) 80 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0542   | 0541   | 0540   | 0539   | 0538   |
| IGV TOTAL PRESSURE RATIO       | 0.998  | 0.998  | 0.997  | 0.996  | 0.996  |
| ROTOR TOTAL PRESSURE RATIO     | 1.254  | 1.253  | 1.244  | 1.233  | 1.216  |
| STATOR TOTAL PRESSURE RATIO    | 0.991  | 0.989  | 0.983  | 0.951  | 0.921  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 0.999  | 1.000  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.079  | 1.076  | 1.073  | 1.069  | 1.066  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | 0.998  | 0.997  | 0.998  | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.848  | 0.878  | 0.887  | 0.891  | 0.871  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.822  | 0.872  | 0.915  | 0.934  | 0.934  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.391  | 0.387  | 0.374  | 0.354  | 0.331  |
| FLOW COEFFICIENT               | 0.370  | 0.419  | 0.466  | 0.507  | 0.537  |
| AIRFLOW PER UNIT FRONTAL AREA  | 91.87  | 103.33 | 113.74 | 123.17 | 129.18 |
| AIRFLOW PER UNIT ANNULUS AREA  | 100.37 | 112.89 | 124.26 | 134.57 | 141.13 |
| AIRFLOW AT ORIFICE             | 18.62  | 20.94  | 23.05  | 24.97  | 26.18  |
| AIRFLOW AT IGV INLET           | 18.65  | 20.94  | 23.06  | 24.93  | 26.14  |
| AIRFLOW AT ROTOR INLET         | 18.65  | 20.96  | 23.08  | 24.93  | 26.19  |
| AIRFLOW AT ROTOR OUTLET        | 18.28  | 20.66  | 22.76  | 24.73  | 26.13  |
| AIRFLOW AT STATOR OUTLET       | 18.21  | 20.10  | 21.91  | 23.79  | 25.24  |
| ROTATIVE SPEED                 | 8687.5 | 8707.8 | 8703.1 | 8719.2 | 8698.7 |
| PERCENT OF DESIGN SPEED        | 79.8   | 80.0   | 79.9   | 80.1   | 79.9   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.241 | 1.237 | 1.219 | 1.190 | 1.151 |
| STAGE TOTAL TEMPERATURE RATIO | 1.077 | 1.073 | 1.069 | 1.066 | 1.063 |
| STAGE ADIABATIC EFFICIENCY    | 0.821 | 0.853 | 0.841 | 0.769 | 0.647 |

## (f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0537   | 0536   | 0535   | 0534   | 0533   |
| IGV TOTAL PRESSURE RATIO       | 0.999  | 0.998  | 0.998  | 0.997  | 0.997  |
| ROTOR TOTAL PRESSURE RATIO     | 1.191  | 1.189  | 1.180  | 1.171  | 1.161  |
| STATOR TOTAL PRESSURE RATIO    | 0.993  | 0.991  | 0.985  | 0.975  | 0.960  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.061  | 1.058  | 1.054  | 1.052  | 1.049  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | 0.998  | 0.999  | 0.999  | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.844  | 0.870  | 0.889  | 0.894  | 0.887  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.864  | 0.913  | 0.946  | 0.951  | 0.960  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.382  | 0.377  | 0.358  | 0.341  | 0.321  |
| FLOW COEFFICIENT               | 0.359  | 0.413  | 0.471  | 0.509  | 0.545  |
| AIRFLOW PER UNIT FRONTAL AREA  | 78.87  | 90.12  | 101.44 | 112.88 | 116.77 |
| AIRFLOW PER UNIT ANNULUS AREA  | 86.17  | 98.46  | 111.27 | 119.76 | 127.57 |
| AIRFLOW AT ORIFICE             | 15.99  | 18.27  | 20.64  | 22.25  | 23.67  |
| AIRFLOW AT IGV INLET           | 16.00  | 18.29  | 20.66  | 22.22  | 23.60  |
| AIRFLOW AT ROTOR INLET         | 15.99  | 18.27  | 20.65  | 22.25  | 23.63  |
| AIRFLOW AT ROTOR OUTLET        | 15.65  | 17.99  | 20.39  | 22.05  | 23.52  |
| AIRFLOW AT STATOR OUTLET       | 15.66  | 17.50  | 19.69  | 21.25  | 22.64  |
| ROTATIVE SPEED                 | 7620.5 | 7629.3 | 7631.8 | 7636.2 | 7630.4 |
| PERCENT OF DESIGN SPEED        | 70.0   | 70.1   | 70.1   | 70.1   | 70.1   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.181 | 1.176 | 1.159 | 1.139 | 1.111 |
| STAGE TOTAL TEMPERATURE RATIO | 1.060 | 1.056 | 1.052 | 1.050 | 1.048 |
| STAGE ADIABATIC EFFICIENCY    | 0.817 | 0.845 | 0.828 | 0.760 | 0.639 |

TABLE III. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2C

(g) 60 percent of design speed

|                                |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|
| READING NUMBER                 | 0530   | 0529   | 0528   | 0527   |
| IGV TOTAL PRESSURE RATIO       | 0.999  | 0.999  | 0.998  | 0.998  |
| ROTOR TOTAL PRESSURE RATIO     | 1.138  | 1.133  | 1.124  | 1.113  |
| STATOR TOTAL PRESSURE RATIO    | 0.995  | 0.993  | 0.984  | 0.970  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.044  | 1.041  | 1.038  | 1.035  |
| STATOR TOTAL TEMPERATURE RATIO | 1.000  | 0.999  | 0.999  | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.857  | 0.883  | 0.898  | 0.892  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.889  | 0.951  | 0.973  | 0.985  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.374  | 0.358  | 0.335  | 0.307  |
| FLOW COEFFICIENT               | 0.356  | 0.433  | 0.496  | 0.551  |
| AIRFLOW PER UNIT FRONTAL AREA  | 67.76  | 81.69  | 93.20  | 102.84 |
| AIRFLOW PER UNIT ANNULUS AREA  | 74.03  | 89.25  | 101.83 | 112.36 |
| AIRFLOW AT ORIFICE             | 13.73  | 16.56  | 18.89  | 20.84  |
| AIRFLOW AT IGV INLET           | 13.75  | 16.58  | 18.86  | 20.79  |
| AIRFLOW AT ROTOR INLET         | 13.84  | 16.64  | 18.91  | 20.87  |
| AIRFLOW AT ROTOR OUTLET        | 13.51  | 16.27  | 18.70  | 20.69  |
| AIRFLOW AT STATOR OUTLET       | 13.43  | 15.86  | 18.08  | 19.98  |
| ROTATIVE SPEED                 | 6559.6 | 6561.0 | 6562.0 | 6560.9 |
| PERCENT OF DESIGN SPEED        | 60.3   | 60.3   | 60.3   | 60.3   |
| COMPRESSOR PERFORMANCE         |        |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.131  | 1.123  | 1.104  | 1.077  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.044  | 1.040  | 1.036  | 1.034  |
| STAGE ADIABATIC EFFICIENCY     | 0.822  | 0.854  | 0.794  | 0.639  |

TABLE IV. - OVERALL PERFORMANCE OF STAGE 57M2D

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0578    | 0577    | 0576    | 0575    | 0574    |
| IGV TOTAL PRESSURE RATIO       | 0.981   | 0.974   | 0.973   | 0.971   | 0.971   |
| ROTOR TOTAL PRESSURE RATIO     | 1.646   | 1.597   | 1.541   | 1.459   | 1.401   |
| STATOR TOTAL PRESSURE RATIO    | 0.965   | 0.958   | 0.945   | 0.949   | 0.933   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.207   | 1.197   | 1.184   | 1.168   | 1.159   |
| STATOR TOTAL TEMPERATURE RATIO | 0.993   | 0.996   | 0.997   | 1.003   | 1.004   |
| ROTOR ADIABATIC EFFICIENCY     | 0.739   | 0.727   | 0.715   | 0.676   | 0.636   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.743   | 0.726   | 0.697   | 0.648   | 0.619   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.443   | 0.409   | 0.372   | 0.316   | 0.281   |
| FLOW COEFFICIENT               | 0.989   | 0.915   | 0.418   | 0.417   | 0.419   |
| AIRFLOW PER UNIT FRONTAL AREA  | 140.15  | 145.82  | 147.19  | 147.04  | 147.23  |
| AIRFLOW PER UNIT ANNULUS AREA  | 153.12  | 159.31  | 160.81  | 160.65  | 160.86  |
| AIRFLOW AT ORIFICE             | 28.41   | 29.56   | 29.83   | 29.80   | 29.84   |
| AIRFLOW AT IGV INLET           | 28.44   | 29.61   | 29.81   | 29.83   | 29.83   |
| AIRFLOW AT ROTOR INLET         | 28.75   | 29.81   | 29.95   | 29.90   | 29.90   |
| AIRFLOW AT ROTOR OUTLET        | 29.14   | 30.01   | 31.09   | 30.53   | 30.32   |
| AIRFLOW AT STATOR OUTLET       | 28.71   | 28.50   | 28.42   | 28.71   | 29.99   |
| ROTATIVE SPEED                 | 13065.5 | 13077.5 | 13084.0 | 13117.3 | 13061.9 |
| PERCENT OF DESIGN SPEED        | 120.0   | 120.1   | 120.2   | 120.5   | 120.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.557 | 1.491 | 1.417 | 1.344 | 1.270 |
| STAGE TOTAL TEMPERATURE RATIO | 1.198 | 1.191 | 1.179 | 1.171 | 1.162 |
| STAGE ADIABATIC EFFICIENCY    | 0.682 | 0.634 | 0.585 | 0.515 | 0.435 |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0573    | 0572    | 0571    | 0570    | 0569    |
| IGV TOTAL PRESSURE RATIO       | 0.985   | 0.979   | 0.977   | 0.976   | 0.976   |
| ROTOR TOTAL PRESSURE RATIO     | 1.558   | 1.530   | 1.485   | 1.428   | 1.364   |
| STATOR TOTAL PRESSURE RATIO    | 0.983   | 0.970   | 0.959   | 0.950   | 0.944   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.173   | 1.165   | 1.158   | 1.149   | 1.139   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.998   | 0.997   | 0.999   | 1.001   |
| ROTOR ADIABATIC EFFICIENCY     | 0.783   | 0.784   | 0.758   | 0.720   | 0.669   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.788   | 0.769   | 0.750   | 0.707   | 0.659   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.450   | 0.430   | 0.395   | 0.361   | 0.321   |
| FLOW COEFFICIENT               | 0.414   | 0.437   | 0.446   | 0.448   | 0.448   |
| AIRFLOW PER UNIT FRONTAL AREA  | 135.46  | 141.56  | 144.18  | 144.73  | 145.08  |
| AIRFLOW PER UNIT ANNULUS AREA  | 147.99  | 154.66  | 157.52  | 158.12  | 158.51  |
| AIRFLOW AT ORIFICE             | 27.45   | 28.69   | 29.22   | 29.33   | 29.41   |
| AIRFLOW AT IGV INLET           | 27.46   | 28.71   | 29.20   | 29.33   | 29.37   |
| AIRFLOW AT ROTOR INLET         | 27.80   | 29.02   | 29.46   | 29.54   | 29.59   |
| AIRFLOW AT ROTOR OUTLET        | 26.78   | 29.04   | 29.73   | 30.04   | 29.70   |
| AIRFLOW AT STATOR OUTLET       | 27.33   | 27.49   | 27.69   | 28.08   | 29.18   |
| ROTATIVE SPEED                 | 11963.5 | 11961.7 | 11969.9 | 11979.3 | 11983.9 |
| PERCENT OF DESIGN SPEED        | 109.9   | 109.9   | 110.0   | 110.0   | 110.1   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.508 | 1.452 | 1.392 | 1.324 | 1.256 |
| STAGE TOTAL TEMPERATURE RATIO | 1.167 | 1.161 | 1.154 | 1.146 | 1.139 |
| STAGE ADIABATIC EFFICIENCY    | 0.744 | 0.697 | 0.644 | 0.573 | 0.486 |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0568    | 0566    | 0565    | 0564    | 0563    |
| IGV TOTAL PRESSURE RATIO       | 0.989   | 0.985   | 0.981   | 0.979   | 0.979   |
| ROTOR TOTAL PRESSURE RATIO     | 1.427   | 1.464   | 1.429   | 1.374   | 1.324   |
| STATOR TOTAL PRESSURE RATIO    | 0.987   | 0.981   | 0.968   | 0.957   | 0.947   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 0.999   | 0.999   | 0.998   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.142   | 1.136   | 1.133   | 1.130   | 1.119   |
| STATOR TOTAL TEMPERATURE RATIO | 0.997   | 1.000   | 0.998   | 0.994   | 0.999   |
| ROTOR ADIABATIC EFFICIENCY     | 0.829   | 0.847   | 0.806   | 0.733   | 0.709   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.832   | 0.837   | 0.799   | 0.757   | 0.726   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.466   | 0.455   | 0.418   | 0.368   | 0.326   |
| FLOW COEFFICIENT               | 0.416   | 0.453   | 0.470   | 0.478   | 0.479   |
| AIRFLOW PER UNIT FRONTAL AREA  | 125.09  | 134.22  | 139.39  | 141.66  | 141.94  |
| AIRFLOW PER UNIT ANNULUS AREA  | 136.66  | 146.64  | 152.29  | 154.77  | 155.08  |
| AIRFLOW AT ORIFICE             | 25.35   | 27.20   | 28.25   | 28.71   | 28.77   |
| AIRFLOW AT IGV INLET           | 25.38   | 27.25   | 28.28   | 28.65   | 28.72   |
| AIRFLOW AT ROTOR INLET         | 25.59   | 27.59   | 28.56   | 28.89   | 28.96   |
| AIRFLOW AT ROTOR OUTLET        | 25.11   | 26.75   | 28.62   | 28.74   | 28.82   |
| AIRFLOW AT STATOR OUTLET       | 25.02   | 26.17   | 26.92   | 27.31   | 28.12   |
| ROTATIVE SPEED                 | 10870.5 | 10848.3 | 10910.5 | 10908.6 | 10901.5 |
| PERCENT OF DESIGN SPEED        | 99.9    | 99.7    | 100.2   | 100.2   | 100.1   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.440 | 1.414 | 1.356 | 1.287 | 1.232 |
| STAGE TOTAL TEMPERATURE RATIO | 1.138 | 1.135 | 1.130 | 1.121 | 1.117 |
| STAGE ADIABATIC EFFICIENCY    | 0.796 | 0.772 | 0.699 | 0.619 | 0.525 |

TABLE IV. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2D

| (d) 90 Percent of design speed |        | (c) 80 Percent of design speed |        |        |        |
|--------------------------------|--------|--------------------------------|--------|--------|--------|
| READING NUMBER                 | 0579   | READING NUMBER                 | 0580   |        |        |
| IGV TOTAL PRESSURE RATIO       | 0.992  | IGV TOTAL PRESSURE RATIO       | 0.994  |        |        |
| ROTOR TOTAL PRESSURE RATIO     | 1.356  | ROTOR TOTAL PRESSURE RATIO     | 1.274  |        |        |
| STATOR TOTAL PRESSURE RATIO    | 0.991  | STATOR TOTAL PRESSURE RATIO    | 0.987  |        |        |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  | IGV TOTAL TEMPERATURE RATIO    | 0.999  |        |        |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.108  | ROTOR TOTAL TEMPERATURE RATIO  | 1.086  |        |        |
| STATOR TOTAL TEMPERATURE RATIO | 1.000  | STATOR TOTAL TEMPERATURE RATIO | 0.999  |        |        |
| ROTOR ADIABATIC EFFICIENCY     | 0.839  | ROTOR ADIABATIC EFFICIENCY     | 0.834  |        |        |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.836  | ROTOR MOMENTUM-RISE EFFICIENCY | 0.844  |        |        |
| ROTOR HEAD-RISE COEFFICIENT    | 0.430  | ROTOR HEAD-RISE COEFFICIENT    | 0.418  |        |        |
| FLOW COEFFICIENT               | 0.403  | FLOW COEFFICIENT               | 0.389  |        |        |
| AIRFLOW PER UNIT FRONTAL AREA  | 110.94 | AIRFLOW PER UNIT FRONTAL AREA  | 96.56  |        |        |
| AIRFLOW PER UNIT ANNULUS AREA  | 121.21 | AIRFLOW PER UNIT ANNULUS AREA  | 105.50 |        |        |
| AIRFLOW AT ORIFICE             | 22.49  | AIRFLOW AT ORIFICE             | 19.57  |        |        |
| AIRFLOW AT IGV INLET           | 22.50  | AIRFLOW AT IGV INLET           | 19.59  |        |        |
| AIRFLOW AT ROTOR INLET         | 22.55  | AIRFLOW AT ROTOR INLET         | 19.61  |        |        |
| AIRFLOW AT ROTOR OUTLET        | 22.35  | AIRFLOW AT ROTOR OUTLET        | 19.53  |        |        |
| AIRFLOW AT STATOR OUTLET       | 21.85  | AIRFLOW AT STATOR OUTLET       | 18.83  |        |        |
| ROTATIVE SPEED                 | 9787.8 | ROTATIVE SPEED                 | 8721.2 |        |        |
| PERCENT OF DESIGN SPEED        | 89.9   | PERCENT OF DESIGN SPEED        | 80.1   |        |        |
| COMPRESSOR PERFORMANCE         |        | COMPRESSOR PERFORMANCE         |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.332  | STAGE TOTAL PRESSURE RATIO     | 1.249  |        |        |
| STAGE TOTAL TEMPERATURE RATIO  | 1.108  | STAGE TOTAL TEMPERATURE RATIO  | 1.084  |        |        |
| STAGE ADIABATIC EFFICIENCY     | 0.793  | STAGE ADIABATIC EFFICIENCY     | 0.784  |        |        |
| (f) 70 Percent of design speed |        |                                |        |        |        |
| READING NUMBER                 | 0587   | 0586                           | 0585   | 0584   | 0583   |
| IGV TOTAL PRESSURE RATIO       | 0.996  | 0.995                          | 0.993  | 0.992  | 0.990  |
| ROTOR TOTAL PRESSURE RATIO     | 1.205  | 1.205                          | 1.195  | 1.188  | 1.184  |
| STATOR TOTAL PRESSURE RATIO    | 0.989  | 0.985                          | 0.978  | 0.970  | 0.960  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 0.999                          | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.065  | 1.062                          | 1.059  | 1.057  | 1.056  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.998                          | 0.999  | 1.000  | 1.000  |
| ROTOR ADIABATIC EFFICIENCY     | 0.841  | 0.878                          | 0.889  | 0.884  | 0.875  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.858  | 0.908                          | 0.921  | 0.921  | 0.925  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.407  | 0.405                          | 0.386  | 0.373  | 0.365  |
| FLOW COEFFICIENT               | 0.393  | 0.445                          | 0.502  | 0.532  | 0.556  |
| AIRFLOW PER UNIT FRONTAL AREA  | 86.36  | 97.68                          | 108.58 | 114.48 | 118.93 |
| AIRFLOW PER UNIT ANNULUS AREA  | 94.35  | 106.72                         | 118.63 | 125.07 | 129.93 |
| AIRFLOW AT ORIFICE             | 17.50  | 19.80                          | 22.01  | 23.20  | 24.10  |
| AIRFLOW AT IGV INLET           | 17.54  | 19.71                          | 22.02  | 23.18  | 24.08  |
| AIRFLOW AT ROTOR INLET         | 17.48  | 19.83                          | 22.04  | 23.22  | 24.08  |
| AIRFLOW AT ROTOR OUTLET        | 17.59  | 19.87                          | 21.66  | 22.77  | 23.67  |
| AIRFLOW AT STATOR OUTLET       | 16.75  | 18.74                          | 20.79  | 21.99  | 23.10  |
| ROTATIVE SPEED                 | 7666.3 | 7665.9                         | 7663.3 | 7656.6 | 7646.7 |
| PERCENT OF DESIGN SPEED        | 70.4   | 70.4                           | 70.4   | 70.3   | 70.2   |
| COMPRESSOR PERFORMANCE         |        |                                |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.187  | 1.180                          | 1.161  | 1.143  | 1.125  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.063  | 1.060                          | 1.057  | 1.056  | 1.056  |
| STAGE ADIABATIC EFFICIENCY     | 0.805  | 0.812                          | 0.758  | 0.689  | 0.610  |
| (g) 60 Percent of design speed |        |                                |        |        |        |
| READING NUMBER                 |        |                                | 0588   |        |        |
| IGV TOTAL PRESSURE RATIO       |        |                                | 0.997  |        |        |
| ROTOR TOTAL PRESSURE RATIO     |        |                                | 1.147  |        |        |
| STATOR TOTAL PRESSURE RATIO    |        |                                | 0.992  |        |        |
| IGV TOTAL TEMPERATURE RATIO    |        |                                | 1.000  |        |        |
| ROTOR TOTAL TEMPERATURE RATIO  |        |                                | 1.048  |        |        |
| STATOR TOTAL TEMPERATURE RATIO |        |                                | 0.998  |        |        |
| ROTOR ADIABATIC EFFICIENCY     |        |                                | 0.835  |        |        |
| ROTOR MOMENTUM-RISE EFFICIENCY |        |                                | 0.854  |        |        |
| ROTOR HEAD-RISE COEFFICIENT    |        |                                | 0.397  |        |        |
| FLOW COEFFICIENT               |        |                                | 0.381  |        |        |
| AIRFLOW PER UNIT FRONTAL AREA  |        |                                | 72.08  |        |        |
| AIRFLOW PER UNIT ANNULUS AREA  |        |                                | 78.75  |        |        |
| AIRFLOW AT ORIFICE             |        |                                | 14.61  |        |        |
| AIRFLOW AT IGV INLET           |        |                                | 14.68  |        |        |
| AIRFLOW AT ROTOR INLET         |        |                                | 14.65  |        |        |
| AIRFLOW AT ROTOR OUTLET        |        |                                | 14.63  |        |        |
| AIRFLOW AT STATOR OUTLET       |        |                                | 14.02  |        |        |
| ROTATIVE SPEED                 |        |                                | 6560.3 |        |        |
| PERCENT OF DESIGN SPEED        |        |                                | 60.3   |        |        |
| COMPRESSOR PERFORMANCE         |        |                                |        |        |        |
| STAGE TOTAL PRESSURE RATIO     |        |                                | 1.134  |        |        |
| STAGE TOTAL TEMPERATURE RATIO  |        |                                | 1.046  |        |        |
| STAGE ADIABATIC EFFICIENCY     |        |                                | 0.803  |        |        |

TABLE V. - OVERALL PERFORMANCE OF STAGE 57M2E

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0606    | 0605    | 0604    | 0603    | 0602    |
| IGV TOTAL PRESSURE RATIO       | 0.994   | 0.993   | 0.993   | 0.993   | 0.993   |
| ROTOR TOTAL PRESSURE RATIO     | 1.554   | 1.461   | 1.391   | 1.335   | 1.270   |
| STATOR TOTAL PRESSURE RATIO    | 0.969   | 0.994   | 1.004   | 0.994   | 0.969   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.153   | 1.139   | 1.128   | 1.120   | 1.105   |
| STATOR TOTAL TEMPERATURE RATIO | 0.993   | 0.992   | 0.992   | 0.990   | 0.989   |
| ROTOR ADIABATIC EFFICIENCY     | 0.879   | 0.824   | 0.776   | 0.718   | 0.672   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.930   | 0.908   | 0.871   | 0.812   | 0.744   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.370   | 0.311   | 0.266   | 0.230   | 0.186   |
| FLOW COEFFICIENT               | 0.347   | 0.374   | 0.383   | 0.385   | 0.385   |
| AIRFLOW PER UNIT FRONTAL AREA  | 126.00  | 134.31  | 136.94  | 137.76  | 138.08  |
| AIRFLOW PER UNIT ANNULUS AREA  | 137.66  | 146.74  | 149.62  | 150.51  | 150.86  |
| AIRFLOW AT ORIFICE             | 25.54   | 27.22   | 27.76   | 27.92   | 27.99   |
| AIRFLOW AT IGV INLET           | 25.52   | 27.20   | 27.77   | 27.87   | 27.95   |
| AIRFLOW AT ROTOR INLET         | 25.13   | 26.80   | 27.39   | 27.51   | 27.57   |
| AIRFLOW AT ROTOR OUTLET        | 24.65   | 25.85   | 26.45   | 27.10   | 28.03   |
| AIRFLOW AT STATOR OUTLET       | 25.64   | 27.22   | 27.91   | 27.61   | 27.40   |
| ROTATIVE SPEED                 | 13082.1 | 13084.2 | 13106.6 | 13100.8 | 13116.9 |
| PERCENT OF DESIGN SPEED        | 120.2   | 120.2   | 120.4   | 120.3   | 120.5   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.497 | 1.444 | 1.387 | 1.318 | 1.223 |
| STAGE TOTAL TEMPERATURE RATIO | 1.143 | 1.128 | 1.118 | 1.107 | 1.093 |
| STAGE ADIABATIC EFFICIENCY    | 0.854 | 0.864 | 0.831 | 0.764 | 0.640 |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0601    | 0600    | 0596    | 0597    | 0599    |
| IGV TOTAL PRESSURE RATIO       | 0.996   | 0.995   | 0.994   | 0.994   | 0.994   |
| ROTOR TOTAL PRESSURE RATIO     | 1.446   | 1.390   | 1.355   | 1.299   | 1.234   |
| STATOR TOTAL PRESSURE RATIO    | 0.975   | 0.991   | 0.991   | 0.990   | 0.973   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.124   | 1.114   | 1.107   | 1.100   | 1.087   |
| STATOR TOTAL TEMPERATURE RATIO | 0.994   | 0.993   | 0.992   | 0.990   | 0.990   |
| ROTOR ADIABATIC EFFICIENCY     | 0.884   | 0.865   | 0.848   | 0.774   | 0.709   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.943   | 0.949   | 0.935   | 0.877   | 0.805   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.358   | 0.314   | 0.288   | 0.245   | 0.193   |
| FLOW COEFFICIENT               | 0.338   | 0.373   | 0.392   | 0.405   | 0.407   |
| AIRFLOW PER UNIT FRONTAL AREA  | 113.55  | 123.99  | 129.34  | 132.94  | 133.72  |
| AIRFLOW PER UNIT ANNULUS AREA  | 124.06  | 135.47  | 141.31  | 145.25  | 146.10  |
| AIRFLOW AT ORIFICE             | 23.02   | 25.13   | 26.22   | 26.95   | 27.10   |
| AIRFLOW AT IGV INLET           | 22.99   | 25.08   | 26.20   | 26.92   | 27.06   |
| AIRFLOW AT ROTOR INLET         | 22.61   | 24.73   | 25.78   | 26.51   | 26.65   |
| AIRFLOW AT ROTOR OUTLET        | 22.31   | 24.31   | 25.49   | 26.41   | 26.65   |
| AIRFLOW AT STATOR OUTLET       | 23.01   | 24.87   | 25.84   | 26.53   | 26.43   |
| ROTATIVE SPEED                 | 11963.2 | 11959.5 | 11950.2 | 11949.4 | 11943.3 |
| PERCENT OF DESIGN SPEED        | 109.9   | 109.9   | 109.8   | 109.8   | 109.7   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.404 | 1.370 | 1.335 | 1.278 | 1.193 |
| STAGE TOTAL TEMPERATURE RATIO | 1.119 | 1.105 | 1.098 | 1.089 | 1.076 |
| STAGE ADIABATIC EFFICIENCY    | 0.859 | 0.897 | 0.881 | 0.820 | 0.685 |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0595    | 0594    | 0593    | 0592    | 0591    |
| IGV TOTAL PRESSURE RATIO       | 0.997   | 0.996   | 0.995   | 0.994   | 0.994   |
| ROTOR TOTAL PRESSURE RATIO     | 1.358   | 1.328   | 1.288   | 1.255   | 1.204   |
| STATOR TOTAL PRESSURE RATIO    | 0.977   | 0.987   | 0.990   | 0.982   | 0.974   |
| IGV TOTAL TEMPERATURE RATIO    | 1.000   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.104   | 1.097   | 1.086   | 1.081   | 1.073   |
| STATOR TOTAL TEMPERATURE RATIO | 0.995   | 0.993   | 0.995   | 0.990   | 0.990   |
| ROTOR ADIABATIC EFFICIENCY     | 0.883   | 0.871   | 0.869   | 0.823   | 0.746   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.938   | 0.950   | 0.953   | 0.933   | 0.858   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.350   | 0.310   | 0.282   | 0.251   | 0.202   |
| FLOW COEFFICIENT               | 0.330   | 0.359   | 0.391   | 0.419   | 0.428   |
| AIRFLOW PER UNIT FRONTAL AREA  | 101.78  | 109.94  | 118.59  | 126.34  | 128.76  |
| AIRFLOW PER UNIT ANNULUS AREA  | 111.20  | 120.12  | 129.57  | 138.04  | 140.67  |
| AIRFLOW AT ORIFICE             | 20.63   | 22.28   | 24.04   | 25.61   | 26.10   |
| AIRFLOW AT IGV INLET           | 20.64   | 22.28   | 24.05   | 25.58   | 26.04   |
| AIRFLOW AT ROTOR INLET         | 20.25   | 21.85   | 23.63   | 25.16   | 25.64   |
| AIRFLOW AT ROTOR OUTLET        | 20.13   | 21.53   | 23.41   | 25.39   | 25.71   |
| AIRFLOW AT STATOR OUTLET       | 20.59   | 21.97   | 23.34   | 25.02   | 25.33   |
| ROTATIVE SPEED                 | 10865.3 | 10870.4 | 10863.2 | 10870.9 | 10869.7 |
| PERCENT OF DESIGN SPEED        | 99.8    | 99.9    | 99.8    | 99.9    | 99.9    |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.323 | 1.305 | 1.268 | 1.226 | 1.166 |
| STAGE TOTAL TEMPERATURE RATIO | 1.097 | 1.089 | 1.080 | 1.070 | 1.061 |
| STAGE ADIABATIC EFFICIENCY    | 0.856 | 0.888 | 0.884 | 0.856 | 0.736 |

TABLE V. - Concluded, OVERALL PERFORMANCE OF STAGE 57M2E

| (d) 90 Percent of design speed |        | (e) 80 Percent of design speed |        |
|--------------------------------|--------|--------------------------------|--------|
| READING NUMBER                 | 0607   | READING NUMBER                 | 0608   |
| IGV TOTAL PRESSURE RATIO       | 0.997  | IGV TOTAL PRESSURE RATIO       | 0.998  |
| ROTOR TOTAL PRESSURE RATIO     | 1.282  | ROTOR TOTAL PRESSURE RATIO     | 1.211  |
| STATOR TOTAL PRESSURE RATIO    | 0.982  | STATOR TOTAL PRESSURE RATIO    | 0.988  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  | IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.084  | ROTOR TOTAL TEMPERATURE RATIO  | 1.064  |
| STATOR TOTAL TEMPERATURE RATIO | 0.996  | STATOR TOTAL TEMPERATURE RATIO | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.878  | ROTOR ADIABATIC EFFICIENCY     | 0.877  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.934  | ROTOR MOMENTUM-RISE EFFICIENCY | 0.934  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.342  | ROTOR HEAD-RISE COEFFICIENT    | 0.328  |
| FLOW COEFFICIENT               | 0.324  | FLOW COEFFICIENT               | 0.325  |
| AIRFLOW PER UNIT FRONTAL AREA  | 90.62  | AIRFLOW PER UNIT FRONTAL AREA  | 88.68  |
| AIRFLOW PER UNIT ANNULUS AREA  | 99.00  | AIRFLOW PER UNIT ANNULUS AREA  | 88.14  |
| AIRFLOW AT ORIFICE             | 18.37  | AIRFLOW AT ORIFICE             | 16.35  |
| AIRFLOW AT IGV INLET           | 18.38  | AIRFLOW AT IGV INLET           | 16.38  |
| AIRFLOW AT ROTOR INLET         | 18.03  | AIRFLOW AT ROTOR INLET         | 16.05  |
| AIRFLOW AT ROTOR OUTLET        | 17.97  | AIRFLOW AT ROTOR OUTLET        | 15.89  |
| AIRFLOW AT STATOR OUTLET       | 18.31  | AIRFLOW AT STATOR OUTLET       | 16.19  |
| ROTATIVE SPEED                 | 9763.0 | ROTATIVE SPEED                 | 8631.0 |
| PERCENT OF DESIGN SPEED        | 89.7   | PERCENT OF DESIGN SPEED        | 79.3   |
| COMPRESSOR PERFORMANCE         |        | COMPRESSOR PERFORMANCE         |        |
| STAGE TOTAL PRESSURE RATIO     | 1.255  | STAGE TOTAL PRESSURE RATIO     | 1.194  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.078  | STAGE TOTAL TEMPERATURE RATIO  | 1.060  |
| STAGE ADIABATIC EFFICIENCY     | 0.856  | STAGE ADIABATIC EFFICIENCY     | 0.862  |

| (f) 70 Percent of design speed |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0614   | 0613   | 0612   | 0611   | 0609   |
| IGV TOTAL PRESSURE RATIO       | 0.998  | 0.998  | 0.998  | 0.997  | 0.997  |
| ROTOR TOTAL PRESSURE RATIO     | 1.162  | 1.150  | 1.135  | 1.118  | 1.095  |
| STATOR TOTAL PRESSURE RATIO    | 0.991  | 0.994  | 0.994  | 0.993  | 0.986  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 1.000  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.050  | 1.046  | 1.042  | 1.037  | 1.032  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.998  | 0.997  | 0.997  | 0.996  |
| ROTOR ADIABATIC EFFICIENCY     | 0.882  | 0.891  | 0.881  | 0.867  | 0.828  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.931  | 0.952  | 0.966  | 0.966  | 0.935  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.322  | 0.299  | 0.269  | 0.236  | 0.191  |
| FLOW COEFFICIENT               | 0.320  | 0.349  | 0.385  | 0.418  | 0.462  |
| AIRFLOW PER UNIT FRONTAL AREA  | 70.84  | 76.71  | 84.26  | 91.14  | 100.15 |
| AIRFLOW PER UNIT ANNULUS AREA  | 77.39  | 83.81  | 92.06  | 99.57  | 109.41 |
| AIRFLOW AT ORIFICE             | 14.36  | 15.55  | 17.08  | 18.47  | 20.30  |
| AIRFLOW AT IGV INLET           | 14.38  | 15.60  | 17.11  | 18.53  | 20.29  |
| AIRFLOW AT ROTOR INLET         | 14.10  | 15.29  | 16.79  | 18.16  | 19.90  |
| AIRFLOW AT ROTOR OUTLET        | 13.92  | 15.03  | 16.71  | 18.10  | 19.80  |
| AIRFLOW AT STATOR OUTLET       | 14.19  | 15.21  | 16.52  | 17.86  | 19.39  |
| ROTATIVE SPEED                 | 7637.0 | 7629.5 | 7632.7 | 7631.4 | 7620.1 |
| PERCENT OF DESIGN SPEED        | 70.2   | 70.1   | 70.1   | 70.1   | 70.0   |
| COMPRESSOR PERFORMANCE         |        |        |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.149  | 1.141  | 1.125  | 1.107  | 1.076  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.047  | 1.043  | 1.038  | 1.033  | 1.027  |
| STAGE ADIABATIC EFFICIENCY     | 0.859  | 0.890  | 0.896  | 0.881  | 0.770  |

| (g) 60 Percent of design speed |        |
|--------------------------------|--------|
| READING NUMBER                 | 0615   |
| IGV TOTAL PRESSURE RATIO       | 0.999  |
| ROTOR TOTAL PRESSURE RATIO     | 1.113  |
| STATOR TOTAL PRESSURE RATIO    | 0.995  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.035  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.880  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.942  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.307  |
| FLOW COEFFICIENT               | 0.328  |
| AIRFLOW PER UNIT FRONTAL AREA  | 62.59  |
| AIRFLOW PER UNIT ANNULUS AREA  | 68.39  |
| AIRFLOW AT ORIFICE             | 12.69  |
| AIRFLOW AT IGV INLET           | 12.72  |
| AIRFLOW AT ROTOR INLET         | 12.47  |
| AIRFLOW AT ROTOR OUTLET        | 12.28  |
| AIRFLOW AT STATOR OUTLET       | 12.46  |
| ROTATIVE SPEED                 | 6558.6 |
| PERCENT OF DESIGN SPEED        | 60.2   |
| COMPRESSOR PERFORMANCE         |        |
| STAGE TOTAL PRESSURE RATIO     | 1.106  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.033  |
| STAGE ADIABATIC EFFICIENCY     | 0.873  |

TABLE VI. - OVERALL PERFORMANCE OF STAGE 57M2F

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0635    | 0634    | 0633    | 0632    | 0631    |
| IGV TOTAL PRESSURE RATIO       | 0.993   | 0.991   | 0.990   | 0.990   | 0.990   |
| ROTOR TOTAL PRESSURE RATIO     | 1.512   | 1.430   | 1.324   | 1.291   | 1.237   |
| STATOR TOTAL PRESSURE RATIO    | 0.961   | 0.984   | 1.008   | 1.046   | 0.974   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.139   | 1.131   | 1.112   | 1.103   | 1.093   |
| STATOR TOTAL TEMPERATURE RATIO | 0.994   | 0.987   | 0.992   | 0.992   | 0.989   |
| ROTOR ADIABATIC EFFICIENCY     | 0.901   | 0.819   | 0.744   | 0.715   | 0.675   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.949   | 0.924   | 0.854   | 0.833   | 0.781   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.343   | 0.292   | 0.223   | 0.201   | 0.165   |
| FLOW COEFFICIENT               | 0.371   | 0.360   | 0.372   | 0.373   | 0.373   |
| AIRFLOW PER UNIT FRONTAL AREA  | 120.67  | 129.42  | 133.18  | 133.59  | 133.70  |
| AIRFLOW PER UNIT ANNULUS AREA  | 131.83  | 141.40  | 145.50  | 145.95  | 146.08  |
| AIRFLOW AT ORIFICE             | 24.46   | 26.23   | 26.99   | 27.08   | 27.10   |
| AIRFLOW AT IGV INLET           | 24.44   | 26.22   | 27.01   | 27.06   | 27.04   |
| AIRFLOW AT ROTOR INLET         | 23.95   | 25.71   | 26.51   | 26.57   | 26.58   |
| AIRFLOW AT ROTOR OUTLET        | 23.76   | 24.78   | 25.85   | 25.89   | 26.95   |
| AIRFLOW AT STATOR OUTLET       | 24.44   | 26.20   | 26.87   | 26.91   | 26.53   |
| ROTATIVE SPEED                 | 13049.0 | 13048.9 | 13048.7 | 13041.5 | 13035.9 |
| PERCENT OF DESIGN SPEED        | 119.9   | 119.9   | 119.9   | 119.8   | 119.7   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.442 | 1.395 | 1.320 | 1.287 | 1.193 |
| STAGE TOTAL TEMPERATURE RATIO | 1.131 | 1.115 | 1.102 | 1.096 | 1.080 |
| STAGE ADIABATIC EFFICIENCY    | 0.839 | 0.865 | 0.813 | 0.774 | 0.643 |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0630    | 0629    | 0628    | 0627    | 0626    |
| IGV TOTAL PRESSURE RATIO       | 0.994   | 0.993   | 0.992   | 0.991   | 0.991   |
| ROTOR TOTAL PRESSURE RATIO     | 1.418   | 1.365   | 1.309   | 1.275   | 1.220   |
| STATOR TOTAL PRESSURE RATIO    | 0.989   | 0.985   | 0.998   | 0.990   | 0.972   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.117   | 1.110   | 1.095   | 1.093   | 1.083   |
| STATOR TOTAL TEMPERATURE RATIO | 0.994   | 0.989   | 0.994   | 0.989   | 0.987   |
| ROTOR ADIABATIC EFFICIENCY     | 0.894   | 0.843   | 0.836   | 0.777   | 0.708   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.962   | 0.947   | 0.936   | 0.910   | 0.839   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.326   | 0.294   | 0.249   | 0.223   | 0.180   |
| FLOW COEFFICIENT               | 0.326   | 0.354   | 0.376   | 0.389   | 0.392   |
| AIRFLOW PER UNIT FRONTAL AREA  | 110.03  | 118.30  | 124.93  | 128.70  | 129.92  |
| AIRFLOW PER UNIT ANNULUS AREA  | 120.21  | 129.24  | 136.49  | 140.62  | 141.94  |
| AIRFLOW AT ORIFICE             | 22.30   | 23.98   | 25.32   | 26.09   | 26.33   |
| AIRFLOW AT IGV INLET           | 22.31   | 24.01   | 25.31   | 26.10   | 26.27   |
| AIRFLOW AT ROTOR INLET         | 21.81   | 23.50   | 24.81   | 25.62   | 25.78   |
| AIRFLOW AT ROTOR OUTLET        | 21.64   | 22.94   | 23.81   | 25.44   | 26.14   |
| AIRFLOW AT STATOR OUTLET       | 22.19   | 23.82   | 24.94   | 25.71   | 25.69   |
| ROTATIVE SPEED                 | 11985.6 | 11981.1 | 11990.0 | 11998.9 | 11984.5 |
| PERCENT OF DESIGN SPEED        | 110.1   | 110.1   | 110.1   | 110.2   | 110.1   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.365 | 1.335 | 1.296 | 1.251 | 1.175 |
| STAGE TOTAL TEMPERATURE RATIO | 1.110 | 1.097 | 1.088 | 1.079 | 1.068 |
| STAGE ADIABATIC EFFICIENCY    | 0.844 | 0.883 | 0.873 | 0.833 | 0.700 |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0625    | 0624    | 0621    | 0620    | 0619    |
| IGV TOTAL PRESSURE RATIO       | 0.995   | 0.994   | 0.994   | 0.992   | 0.993   |
| ROTOR TOTAL PRESSURE RATIO     | 1.337   | 1.302   | 1.253   | 1.186   | 1.233   |
| STATOR TOTAL PRESSURE RATIO    | 0.974   | 0.984   | 0.995   | 0.977   | 0.986   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.097   | 1.091   | 1.079   | 1.067   | 1.075   |
| STATOR TOTAL TEMPERATURE RATIO | 0.994   | 0.991   | 0.994   | 0.990   | 0.991   |
| ROTOR ADIABATIC EFFICIENCY     | 0.888   | 0.858   | 0.845   | 0.753   | 0.819   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.951   | 0.958   | 0.952   | 0.882   | 0.962   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.328   | 0.295   | 0.248   | 0.184   | 0.229   |
| FLOW COEFFICIENT               | 0.321   | 0.348   | 0.376   | 0.412   | 0.398   |
| AIRFLOW PER UNIT FRONTAL AREA  | 99.20   | 106.82  | 114.21  | 124.66  | 120.68  |
| AIRFLOW PER UNIT ANNULUS AREA  | 108.39  | 116.71  | 125.54  | 136.20  | 131.84  |
| AIRFLOW AT ORIFICE             | 20.11   | 21.65   | 23.29   | 25.27   | 24.46   |
| AIRFLOW AT IGV INLET           | 20.12   | 21.65   | 23.27   | 25.24   | 24.47   |
| AIRFLOW AT ROTOR INLET         | 19.67   | 21.17   | 22.80   | 24.76   | 23.97   |
| AIRFLOW AT ROTOR OUTLET        | 19.64   | 20.90   | 22.19   | 24.85   | 23.80   |
| AIRFLOW AT STATOR OUTLET       | 19.94   | 21.39   | 22.80   | 24.84   | 23.83   |
| ROTATIVE SPEED                 | 10869.5 | 10879.3 | 10888.3 | 10888.6 | 10886.4 |
| PERCENT OF DESIGN SPEED        | 99.8    | 99.9    | 100.0   | 100.0   | 100.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.295 | 1.273 | 1.239 | 1.149 | 1.208 |
| STAGE TOTAL TEMPERATURE RATIO | 1.090 | 1.081 | 1.072 | 1.054 | 1.064 |
| STAGE ADIABATIC EFFICIENCY    | 0.849 | 0.882 | 0.883 | 0.754 | 0.858 |

TABLE VI. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2F

| (d) 90 Percent of design speed |        | (e) 80 Percent of design speed |        |
|--------------------------------|--------|--------------------------------|--------|
| READING NUMBER                 | 0636   | READING NUMBER                 | 0637   |
| IGV TOTAL PRESSURE RATIO       | 0.996  | IGV TOTAL PRESSURE RATIO       | 0.997  |
| ROTOR TOTAL PRESSURE RATIO     | 1.265  | ROTOR TOTAL PRESSURE RATIO     | 1.206  |
| STATOR TOTAL PRESSURE RATIO    | 0.980  | STATOR TOTAL PRESSURE RATIO    | 0.984  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  | IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.078  | ROTOR TOTAL TEMPERATURE RATIO  | 1.062  |
| STATOR TOTAL TEMPERATURE RATIO | 0.996  | STATOR TOTAL TEMPERATURE RATIO | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.889  | ROTOR ADIABATIC EFFICIENCY     | 0.890  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.943  | ROTOR MOMENTUM-RISE EFFICIENCY | 0.944  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.320  | ROTOR HEAD-RISE COEFFICIENT    | 0.315  |
| FLOW COEFFICIENT               | 0.316  | FLOW COEFFICIENT               | 0.311  |
| AIRFLOW PER UNIT FRONTAL AREA  | 88.37  | AIRFLOW PER UNIT FRONTAL AREA  | 78.03  |
| AIRFLOW PER UNIT ANNULUS AREA  | 96.55  | AIRFLOW PER UNIT ANNULUS AREA  | 85.25  |
| AIRFLOW AT ORIFICE             | 17.91  | AIRFLOW AT ORIFICE             | 15.82  |
| AIRFLOW AT IGV INLET           | 17.96  | AIRFLOW AT IGV INLET           | 15.86  |
| AIRFLOW AT ROTOR INLET         | 17.55  | AIRFLOW AT ROTOR INLET         | 15.58  |
| AIRFLOW AT ROTOR OUTLET        | 17.37  | AIRFLOW AT ROTOR OUTLET        | 15.33  |
| AIRFLOW AT STATOR OUTLET       | 17.81  | AIRFLOW AT STATOR OUTLET       | 15.70  |
| ROTATIVE SPEED                 | 9782.6 | ROTATIVE SPEED                 | 8713.7 |
| PERCENT OF DESIGN SPEED        | 89.9   | PERCENT OF DESIGN SPEED        | 80.0   |
| COMPRESSOR PERFORMANCE         |        | COMPRESSOR PERFORMANCE         |        |
| STAGE TOTAL PRESSURE RATIO     | 1.235  | STAGE TOTAL PRESSURE RATIO     | 1.184  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.074  | STAGE TOTAL TEMPERATURE RATIO  | 1.058  |
| STAGE ADIABATIC EFFICIENCY     | 0.845  | STAGE ADIABATIC EFFICIENCY     | 0.847  |

(f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0643   | 0641   | 0640   | 0639   | 0638   |
| IGV TOTAL PRESSURE RATIO       | 0.998  | 0.997  | 0.997  | 0.996  | 0.995  |
| ROTOR TOTAL PRESSURE RATIO     | 1.153  | 1.133  | 1.116  | 1.104  | 1.083  |
| STATOR TOTAL PRESSURE RATIO    | 0.989  | 0.995  | 0.995  | 0.992  | 0.987  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.046  | 1.042  | 1.036  | 1.033  | 1.028  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.997  | 0.998  | 0.996  | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.894  | 0.875  | 0.882  | 0.867  | 0.838  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.948  | 0.979  | 1.007  | 1.018  | 0.968  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.306  | 0.267  | 0.233  | 0.209  | 0.167  |
| FLOW COEFFICIENT               | 0.308  | 0.348  | 0.302  | 0.413  | 0.444  |
| AIRFLOW PER UNIT FRONTAL AREA  | 68.81  | 76.39  | 83.54  | 89.99  | 96.34  |
| AIRFLOW PER UNIT ANNULUS AREA  | 75.17  | 83.45  | 91.27  | 98.32  | 105.26 |
| AIRFLOW AT ORIFICE             | 13.95  | 15.48  | 16.93  | 18.24  | 19.53  |
| AIRFLOW AT IGV INLET           | 13.79  | 15.53  | 17.00  | 18.29  | 19.55  |
| AIRFLOW AT ROTOR INLET         | 13.67  | 15.18  | 16.62  | 17.88  | 19.11  |
| AIRFLOW AT ROTOR OUTLET        | 13.46  | 14.48  | 16.07  | 17.55  | 19.02  |
| AIRFLOW AT STATOR OUTLET       | 13.76  | 15.11  | 16.39  | 17.62  | 18.70  |
| ROTATIVE SPEED                 | 7631.4 | 7627.5 | 7621.5 | 7631.0 | 7622.5 |
| PERCENT OF DESIGN SPEED        | 70.1   | 70.1   | 70.0   | 70.1   | 70.0   |
| COMPRESSOR PERFORMANCE         |        |        |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.138  | 1.124  | 1.107  | 1.091  | 1.064  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.044  | 1.038  | 1.033  | 1.029  | 1.023  |
| STAGE ADIABATIC EFFICIENCY     | 0.847  | 0.886  | 0.890  | 0.870  | 0.766  |

(g) 60 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0644   |
| IGV TOTAL PRESSURE RATIO       | 0.998  |
| ROTOR TOTAL PRESSURE RATIO     | 1.107  |
| STATOR TOTAL PRESSURE RATIO    | 0.993  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.033  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.898  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.955  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.294  |
| FLOW COEFFICIENT               | 0.317  |
| AIRFLOW PER UNIT FRONTAL AREA  | 60.23  |
| AIRFLOW PER UNIT ANNULUS AREA  | 65.88  |
| AIRFLOW AT ORIFICE             | 12.21  |
| AIRFLOW AT IGV INLET           | 12.24  |
| AIRFLOW AT ROTOR INLET         | 11.99  |
| AIRFLOW AT ROTOR OUTLET        | 11.78  |
| AIRFLOW AT STATOR OUTLET       | 11.93  |
| ROTATIVE SPEED                 | 6525.1 |
| PERCENT OF DESIGN SPEED        | 59.9   |
| COMPRESSOR PERFORMANCE         |        |
| STAGE TOTAL PRESSURE RATIO     | 1.097  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.031  |
| STAGE ADIABATIC EFFICIENCY     | 0.855  |

TABLE VII. - OVERALL PERFORMANCE OF STAGE 57M2G

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0662    | 0661    | 0660    | 0659    | 0658    |
| IGV TOTAL PRESSURE RATIO       | 0.992   | 0.990   | 0.989   | 0.989   | 0.988   |
| ROTOR TOTAL PRESSURE RATIO     | 1.466   | 1.390   | 1.319   | 1.259   | 1.218   |
| STATOR TOTAL PRESSURE RATIO    | 0.955   | 0.983   | 0.991   | 0.999   | 0.970   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.133   | 1.121   | 1.108   | 1.098   | 1.088   |
| STATOR TOTAL TEMPERATURE RATIO | 0.990   | 0.988   | 0.989   | 0.989   | 0.988   |
| ROTOR ADIABATIC EFFICIENCY     | 0.866   | 0.815   | 0.759   | 0.693   | 0.663   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.947   | 0.909   | 0.890   | 0.839   | 0.781   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.312   | 0.264   | 0.217   | 0.178   | 0.151   |
| FLOW COEFFICIENT               | 0.312   | 0.333   | 0.347   | 0.350   | 0.350   |
| AIRFLOW PER UNIT FRONTAL AREA  | 115.01  | 121.77  | 126.00  | 126.82  | 126.99  |
| AIRFLOW PER UNIT ANNULUS AREA  | 125.65  | 133.03  | 137.66  | 138.56  | 138.74  |
| AIRFLOW AT ORIFICE             | 23.31   | 24.68   | 25.54   | 25.71   | 25.74   |
| AIRFLOW AT IGV INLET           | 23.26   | 24.64   | 25.53   | 25.66   | 25.71   |
| AIRFLOW AT ROTOR INLET         | 23.20   | 24.62   | 25.56   | 25.72   | 25.74   |
| AIRFLOW AT ROTOR OUTLET        | 22.60   | 23.36   | 24.81   | 25.05   | 25.65   |
| AIRFLOW AT STATOR OUTLET       | 23.27   | 24.84   | 25.54   | 25.75   | 25.22   |
| ROTATIVE SPEED                 | 13102.7 | 13102.7 | 13099.4 | 13085.1 | 13082.7 |
| PERCENT OF DESIGN SPEED        | 120.4   | 120.4   | 120.3   | 120.2   | 120.2   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.389 | 1.353 | 1.292 | 1.243 | 1.168 |
| STAGE TOTAL TEMPERATURE RATIO | 1.120 | 1.107 | 1.094 | 1.095 | 1.073 |
| STAGE ADIABATIC EFFICIENCY    | 0.818 | 0.847 | 0.806 | 0.754 | 0.622 |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0657    | 0656    | 0655    | 0654    | 0653    |
| IGV TOTAL PRESSURE RATIO       | 0.995   | 0.993   | 0.992   | 0.991   | 0.990   |
| ROTOR TOTAL PRESSURE RATIO     | 1.372   | 1.330   | 1.281   | 1.242   | 1.192   |
| STATOR TOTAL PRESSURE RATIO    | 0.966   | 0.983   | 0.994   | 0.986   | 0.980   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.110   | 1.101   | 1.089   | 1.084   | 1.073   |
| STATOR TOTAL TEMPERATURE RATIO | 0.991   | 0.992   | 0.994   | 0.988   | 0.989   |
| ROTOR ADIABATIC EFFICIENCY     | 0.858   | 0.840   | 0.822   | 0.765   | 0.700   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.947   | 0.930   | 0.922   | 0.926   | 0.841   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.307   | 0.269   | 0.230   | 0.200   | 0.171   |
| FLOW COEFFICIENT               | 0.310   | 0.327   | 0.345   | 0.364   | 0.369   |
| AIRFLOW PER UNIT FRONTAL AREA  | 104.73  | 110.06  | 115.41  | 120.80  | 122.40  |
| AIRFLOW PER UNIT ANNULUS AREA  | 114.43  | 120.24  | 126.09  | 131.98  | 133.73  |
| AIRFLOW AT ORIFICE             | 21.23   | 22.31   | 23.39   | 24.49   | 24.81   |
| AIRFLOW AT IGV INLET           | 21.21   | 22.27   | 23.41   | 24.48   | 24.81   |
| AIRFLOW AT ROTOR INLET         | 21.08   | 22.19   | 23.39   | 24.48   | 24.83   |
| AIRFLOW AT ROTOR OUTLET        | 20.56   | 21.26   | 22.20   | 24.01   | 24.49   |
| AIRFLOW AT STATOR OUTLET       | 21.15   | 22.32   | 23.29   | 24.21   | 24.41   |
| ROTATIVE SPEED                 | 11916.5 | 11919.8 | 11933.0 | 11955.1 | 11915.9 |
| PERCENT OF DESIGN SPEED        | 109.5   | 109.5   | 109.6   | 109.4   | 109.5   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.319 | 1.299 | 1.264 | 1.213 | 1.156 |
| STAGE TOTAL TEMPERATURE RATIO | 1.099 | 1.091 | 1.081 | 1.070 | 1.060 |
| STAGE ADIABATIC EFFICIENCY    | 0.830 | 0.854 | 0.851 | 0.816 | 0.706 |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0652    | 0651    | 0650    | 0649    | 0648    |
| IGV TOTAL PRESSURE RATIO       | 0.996   | 0.995   | 0.994   | 0.992   | 0.991   |
| ROTOR TOTAL PRESSURE RATIO     | 1.310   | 1.267   | 1.222   | 1.186   | 1.159   |
| STATOR TOTAL PRESSURE RATIO    | 0.968   | 0.985   | 0.992   | 0.985   | 0.977   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.092   | 1.083   | 1.072   | 1.067   | 1.058   |
| STATOR TOTAL TEMPERATURE RATIO | 0.993   | 0.992   | 0.993   | 0.990   | 0.991   |
| ROTOR ADIABATIC EFFICIENCY     | 0.868   | 0.839   | 0.815   | 0.788   | 0.744   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.944   | 0.929   | 0.944   | 0.936   | 0.890   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.304   | 0.263   | 0.220   | 0.195   | 0.158   |
| FLOW COEFFICIENT               | 0.303   | 0.327   | 0.353   | 0.373   | 0.386   |
| AIRFLOW PER UNIT FRONTAL AREA  | 93.96   | 100.60  | 107.92  | 113.58  | 117.38  |
| AIRFLOW PER UNIT ANNULUS AREA  | 102.65  | 109.91  | 117.51  | 124.09  | 128.24  |
| AIRFLOW AT ORIFICE             | 19.04   | 20.39   | 21.87   | 23.02   | 23.79   |
| AIRFLOW AT IGV INLET           | 19.03   | 20.44   | 21.89   | 23.03   | 23.73   |
| AIRFLOW AT ROTOR INLET         | 18.91   | 20.31   | 21.83   | 23.00   | 23.69   |
| AIRFLOW AT ROTOR OUTLET        | 18.49   | 19.53   | 21.00   | 22.72   | 23.55   |
| AIRFLOW AT STATOR OUTLET       | 18.91   | 20.36   | 21.59   | 22.61   | 23.05   |
| ROTATIVE SPEED                 | 10851.4 | 10848.2 | 10841.6 | 10844.8 | 10847.7 |
| PERCENT OF DESIGN SPEED        | 99.7    | 99.7    | 99.6    | 99.6    | 99.6    |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.263 | 1.242 | 1.206 | 1.170 | 1.123 |
| STAGE TOTAL TEMPERATURE RATIO | 1.084 | 1.074 | 1.064 | 1.056 | 1.046 |
| STAGE ADIABATIC EFFICIENCY    | 0.819 | 0.861 | 0.861 | 0.825 | 0.728 |

TABLE VII. - Continued. OVERALL PERFORMANCE OF STAGE 57M2G

## (d) 90 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0.667  | 0.666  | 0.665  | 0.664  | 0.663  |
| ICV TOTAL PRESSURE RATIO       | 0.997  | 0.996  | 0.995  | 0.994  | 0.993  |
| ROTOR TOTAL PRESSURE RATIO     | 1.252  | 1.204  | 1.179  | 1.157  | 1.128  |
| STATOR TOTAL PRESSURE RATIO    | 0.974  | 0.993  | 0.995  | 0.986  | 0.981  |
| ICV TOTAL TEMPERATURE RATIO    | 1.000  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.076  | 1.064  | 1.058  | 1.053  | 1.045  |
| STATOR TOTAL TEMPERATURE RATIO | 0.995  | 0.996  | 0.995  | 0.993  | 0.993  |
| ROTOR ADIABATIC EFFICIENCY     | 0.869  | 0.850  | 0.834  | 0.804  | 0.773  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.933  | 0.931  | 0.946  | 0.947  | 0.914  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.301  | 0.244  | 0.215  | 0.189  | 0.155  |
| FLOW COEFFICIENT               | 0.295  | 0.333  | 0.354  | 0.380  | 0.396  |
| AIRFLOW PER UNIT FRONTAL AREA  | 83.74  | 93.34  | 98.97  | 105.63 | 109.80 |
| AIRFLOW PER UNIT ANNULUS AREA  | 91.51  | 101.98 | 108.13 | 115.41 | 119.96 |
| AIRFLOW AT DRIFICE             | 16.98  | 18.92  | 20.06  | 21.41  | 22.26  |
| AIRFLOW AT ICV INLET           | 16.97  | 18.96  | 20.09  | 21.42  | 22.23  |
| AIRFLOW AT ROTOR INLET         | 16.86  | 18.86  | 19.98  | 21.35  | 22.17  |
| AIRFLOW AT ROTOR OUTLET        | 16.36  | 17.99  | 19.29  | 21.20  | 22.15  |
| AIRFLOW AT STATOR OUTLET       | 16.89  | 18.78  | 19.82  | 20.89  | 21.58  |
| ROTATIVE SPEED                 | 9843.6 | 9841.5 | 9831.5 | 9837.7 | 9831.9 |
| PERCENT OF DESIGN SPEED        | 90.4   | 90.4   | 90.3   | 90.4   | 90.3   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.215 | 1.190 | 1.167 | 1.134 | 1.100 |
| STAGE TOTAL TEMPERATURE RATIO | 1.071 | 1.059 | 1.052 | 1.044 | 1.037 |
| STAGE ADIABATIC EFFICIENCY    | 0.810 | 0.869 | 0.871 | 0.829 | 0.745 |

## (e) 80 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0.674  | 0.673  | 0.670  | 0.669  | 0.668  |
| ICV TOTAL PRESSURE RATIO       | 0.997  | 0.996  | 0.996  | 0.995  | 0.995  |
| ROTOR TOTAL PRESSURE RATIO     | 1.198  | 1.153  | 1.134  | 1.115  | 1.096  |
| STATOR TOTAL PRESSURE RATIO    | 1.078  | 0.995  | 0.991  | 0.988  | 0.984  |
| ICV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.061  | 1.049  | 1.044  | 1.039  | 1.033  |
| STATOR TOTAL TEMPERATURE RATIO | 0.996  | 0.997  | 0.995  | 0.995  | 0.995  |
| ROTOR ADIABATIC EFFICIENCY     | 0.869  | 0.850  | 0.824  | 0.820  | 0.799  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.929  | 0.935  | 0.959  | 0.953  | 0.925  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.302  | 0.234  | 0.206  | 0.177  | 0.149  |
| FLOW COEFFICIENT               | 0.294  | 0.344  | 0.366  | 0.389  | 0.405  |
| AIRFLOW PER UNIT FRONTAL AREA  | 74.16  | 85.87  | 90.99  | 96.23  | 100.14 |
| AIRFLOW PER UNIT ANNULUS AREA  | 81.02  | 93.81  | 99.41  | 105.14 | 109.40 |
| AIRFLOW AT DRIFICE             | 15.03  | 17.40  | 18.44  | 19.51  | 20.30  |
| AIRFLOW AT ICV INLET           | 15.07  | 17.46  | 18.49  | 19.55  | 20.29  |
| AIRFLOW AT ROTOR INLET         | 14.86  | 17.26  | 18.34  | 19.46  | 20.21  |
| AIRFLOW AT ROTOR OUTLET        | 14.50  | 16.58  | 18.03  | 19.34  | 20.17  |
| AIRFLOW AT STATOR OUTLET       | 14.83  | 17.07  | 17.99  | 18.91  | 19.52  |
| ROTATIVE SPEED                 | 8717.3 | 8715.4 | 8704.6 | 8697.9 | 8704.2 |
| PERCENT OF DESIGN SPEED        | 80.1   | 80.1   | 80.0   | 79.9   | 80.0   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.168 | 1.143 | 1.119 | 1.096 | 1.074 |
| STAGE TOTAL TEMPERATURE RATIO | 1.056 | 1.045 | 1.038 | 1.032 | 1.028 |
| STAGE ADIABATIC EFFICIENCY    | 0.807 | 0.862 | 0.857 | 0.820 | 0.739 |

## (f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0.685  | 0.684  | 0.683  | 0.682  | 0.680  |
| ICV TOTAL PRESSURE RATIO       | 0.998  | 0.997  | 0.997  | 0.996  | 0.996  |
| ROTOR TOTAL PRESSURE RATIO     | 1.147  | 1.107  | 1.101  | 1.090  | 1.076  |
| STATOR TOTAL PRESSURE RATIO    | 0.985  | 0.995  | 0.993  | 0.991  | 0.987  |
| ICV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 1.000  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.046  | 1.038  | 1.035  | 1.029  | 1.026  |
| STATOR TOTAL TEMPERATURE RATIO | 0.997  | 0.998  | 0.996  | 0.997  | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.869  | 0.861  | 0.855  | 0.846  | 0.820  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.930  | 0.936  | 0.956  | 0.950  | 0.926  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.293  | 0.238  | 0.215  | 0.179  | 0.152  |
| FLOW COEFFICIENT               | 0.297  | 0.339  | 0.368  | 0.400  | 0.421  |
| AIRFLOW PER UNIT FRONTAL AREA  | 65.97  | 74.86  | 80.73  | 87.48  | 91.99  |
| AIRFLOW PER UNIT ANNULUS AREA  | 72.07  | 81.98  | 88.27  | 95.50  | 100.51 |
| AIRFLOW AT DRIFICE             | 13.37  | 15.17  | 16.36  | 17.73  | 18.65  |
| AIRFLOW AT ICV INLET           | 13.38  | 15.22  | 16.42  | 17.81  | 18.68  |
| AIRFLOW AT ROTOR INLET         | 13.26  | 15.06  | 16.24  | 17.62  | 18.52  |
| AIRFLOW AT ROTOR OUTLET        | 12.95  | 14.44  | 15.96  | 17.51  | 18.50  |
| AIRFLOW AT STATOR OUTLET       | 13.21  | 14.86  | 15.86  | 17.10  | 17.86  |
| ROTATIVE SPEED                 | 7642.7 | 7650.9 | 7635.5 | 7648.7 | 7649.5 |
| PERCENT OF DESIGN SPEED        | 70.2   | 70.3   | 70.1   | 70.3   | 70.3   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.128 | 1.112 | 1.096 | 1.076 | 1.058 |
| STAGE TOTAL TEMPERATURE RATIO | 1.043 | 1.036 | 1.031 | 1.026 | 1.022 |
| STAGE ADIABATIC EFFICIENCY    | 0.821 | 0.868 | 0.858 | 0.820 | 0.742 |

TABLE VII. - Concluded, OVERALL PERFORMANCE OF STAGE 57M2G

(g) 60 Percent of design speed

| READING NUMBER                 | 0679   | 0678   | 0677   | 0676   | 0675   |
|--------------------------------|--------|--------|--------|--------|--------|
| IGV TOTAL PRESSURE RATIO       | 0.999  | 0.998  | 0.998  | 0.997  | 0.997  |
| ROTOR TOTAL PRESSURE RATIO     | 1.106  | 1.087  | 1.076  | 1.062  | 1.049  |
| STATOR TOTAL PRESSURE RATIO    | 0.989  | 0.997  | 0.993  | 0.992  | 0.989  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 1.000  | 1.000  | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.033  | 1.028  | 1.025  | 1.020  | 1.017  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  | 0.999  | 0.997  | 0.998  | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.871  | 0.861  | 0.836  | 0.854  | 0.808  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.930  | 0.941  | 0.963  | 0.953  | 0.920  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.289  | 0.237  | 0.208  | 0.170  | 0.136  |
| FLOW COEFFICIENT               | 0.294  | 0.334  | 0.374  | 0.410  | 0.435  |
| AIRFLOW PER UNIT FRONTAL AREA  | 55.88  | 63.38  | 70.52  | 76.90  | 81.28  |
| AIRFLOW PER UNIT ANNULUS AREA  | 61.06  | 69.24  | 77.04  | 84.02  | 88.80  |
| AIRFLOW AT ORIFICE             | 11.33  | 12.85  | 14.29  | 15.59  | 16.47  |
| AIRFLOW AT IGV INLET           | 11.35  | 12.89  | 14.35  | 15.66  | 16.54  |
| AIRFLOW AT ROTOR INLET         | 11.28  | 12.77  | 14.19  | 15.47  | 16.33  |
| AIRFLOW AT ROTOR OUTLET        | 11.01  | 12.29  | 14.04  | 15.44  | 16.36  |
| AIRFLOW AT STATOR OUTLET       | 11.17  | 12.56  | 13.74  | 14.96  | 15.76  |
| ROTATIVE SPEED                 | 6522.9 | 6528.8 | 6518.6 | 6526.9 | 6511.9 |
| PERCENT OF DESIGN SPEED        | 59.9   | 60.0   | 59.9   | 60.0   | 59.8   |
| COMPRESSOR PERFORMANCE         |        |        |        |        |        |
| STAGE TOTAL PRESSURE RATIO     | 1.092  | 1.081  | 1.066  | 1.051  | 1.034  |
| STAGE TOTAL TEMPERATURE RATIO  | 1.031  | 1.026  | 1.022  | 1.018  | 1.014  |
| STAGE ADIABATIC EFFICIENCY     | 0.813  | 0.856  | 0.843  | 0.788  | 0.669  |

TABLE VIII. - OVERALL PERFORMANCE OF STAGE 57M2H

## (a) 120 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0704    | 0703    | 0702    | 0701    | 0700    |
| IGV TOTAL PRESSURE RATIO       | 0.981   | 0.978   | 0.975   | 0.974   | 0.974   |
| ROTOR TOTAL PRESSURE RATIO     | 1.437   | 1.401   | 1.333   | 1.250   | 1.188   |
| STATOR TOTAL PRESSURE RATIO    | 0.952   | 0.957   | 0.974   | 0.994   | 1.080   |
| IGV TOTAL TEMPERATURE RATIO    | 0.998   | 0.998   | 0.998   | 0.998   | 0.998   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.122   | 1.117   | 1.106   | 1.094   | 1.085   |
| STATOR TOTAL TEMPERATURE RATIO | 0.997   | 0.989   | 0.988   | 0.989   | 0.989   |
| ROTOR ADIABATIC EFFICIENCY     | 0.896   | 0.864   | 0.804   | 0.700   | 0.593   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.980   | 0.994   | 0.957   | 0.879   | 0.819   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.292   | 0.270   | 0.270   | 0.172   | 0.153   |
| FLOW COEFFICIENT               | 0.297   | 0.314   | 0.327   | 0.334   | 0.335   |
| AIRFLOW PER UNIT FRONTAL AREA  | 109.84  | 115.02  | 119.41  | 121.67  | 122.11  |
| AIRFLOW PER UNIT ANNULUS AREA  | 120.00  | 125.66  | 130.46  | 132.93  | 133.42  |
| AIRFLOW AT ORIFICE             | 22.26   | 23.31   | 24.20   | 24.66   | 24.75   |
| AIRFLOW AT IGV INLET           | 22.23   | 23.31   | 24.20   | 24.66   | 24.72   |
| AIRFLOW AT ROTOR INLET         | 21.78   | 22.87   | 23.72   | 24.24   | 24.32   |
| AIRFLOW AT ROTOR OUTLET        | 21.74   | 23.07   | 23.53   | 23.20   | 23.09   |
| AIRFLOW AT STATOR OUTLET       | 22.40   | 23.41   | 24.31   | 24.55   | 24.52   |
| ROTATIVE SPEED                 | 13089.9 | 13079.1 | 13084.5 | 13086.9 | 13078.4 |
| PERCENT OF DESIGN SPEED        | 120.2   | 120.1   | 120.2   | 120.2   | 120.1   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.343   | 1.311   | 1.266   | 1.210   | 1.157   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.116   | 1.103   | 1.091   | 1.080   | 1.071   |
| STAGE ADIABATIC EFFICIENCY     | 0.755   | 0.781   | 0.765   | 0.701   | 0.660   |

## (b) 110 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0699    | 0698    | 0697    | 0696    | 0695    |
| IGV TOTAL PRESSURE RATIO       | 0.985   | 0.983   | 0.981   | 0.977   | 0.976   |
| ROTOR TOTAL PRESSURE RATIO     | 1.360   | 1.335   | 1.295   | 1.204   | 1.163   |
| STATOR TOTAL PRESSURE RATIO    | 0.960   | 0.965   | 0.975   | 0.995   | 0.998   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.998   | 0.998   | 0.998   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.103   | 1.099   | 1.091   | 1.076   | 1.070   |
| STATOR TOTAL TEMPERATURE RATIO | 0.996   | 0.992   | 0.990   | 0.990   | 0.990   |
| ROTOR ADIABATIC EFFICIENCY     | 0.923   | 0.923   | 0.929   | 0.711   | 0.627   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.972   | 0.994   | 0.971   | 0.918   | 0.865   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.288   | 0.269   | 0.235   | 0.167   | 0.134   |
| FLOW COEFFICIENT               | 0.295   | 0.310   | 0.327   | 0.347   | 0.352   |
| AIRFLOW PER UNIT FRONTAL AREA  | 100.60  | 105.38  | 110.44  | 116.43  | 118.01  |
| AIRFLOW PER UNIT ANNULUS AREA  | 109.91  | 115.13  | 120.66  | 127.20  | 128.93  |
| AIRFLOW AT ORIFICE             | 20.39   | 21.36   | 22.39   | 23.60   | 23.92   |
| AIRFLOW AT IGV INLET           | 20.39   | 21.35   | 22.40   | 23.61   | 23.92   |
| AIRFLOW AT ROTOR INLET         | 19.91   | 20.92   | 21.85   | 23.07   | 23.36   |
| AIRFLOW AT ROTOR OUTLET        | 19.82   | 21.06   | 21.91   | 22.13   | 22.39   |
| AIRFLOW AT STATOR OUTLET       | 20.45   | 21.28   | 22.22   | 23.22   | 23.56   |
| ROTATIVE SPEED                 | 11988.7 | 11992.0 | 11983.5 | 11982.8 | 11984.1 |
| PERCENT OF DESIGN SPEED        | 110.1   | 110.2   | 110.1   | 110.1   | 110.1   |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.286   | 1.266   | 1.235   | 1.170   | 1.134   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.098   | 1.089   | 1.079   | 1.064   | 1.057   |
| STAGE ADIABATIC EFFICIENCY     | 0.762   | 0.787   | 0.791   | 0.717   | 0.637   |

## (c) 100 Percent of design speed

|                                |         |         |         |         |         |
|--------------------------------|---------|---------|---------|---------|---------|
| READING NUMBER                 | 0694    | 0693    | 0692    | 0691    | 0690    |
| IGV TOTAL PRESSURE RATIO       | 0.988   | 0.986   | 0.984   | 0.981   | 0.980   |
| ROTOR TOTAL PRESSURE RATIO     | 1.293   | 1.256   | 1.220   | 1.169   | 1.133   |
| STATOR TOTAL PRESSURE RATIO    | 0.966   | 0.973   | 0.982   | 0.996   | 0.999   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.998   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.085   | 1.078   | 1.072   | 1.062   | 1.056   |
| STATOR TOTAL TEMPERATURE RATIO | 0.997   | 0.992   | 0.991   | 0.992   | 0.991   |
| ROTOR ADIABATIC EFFICIENCY     | 0.894   | 0.862   | 0.811   | 0.733   | 0.648   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.978   | 0.987   | 0.960   | 0.923   | 0.900   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.285   | 0.251   | 0.217   | 0.167   | 0.132   |
| FLOW COEFFICIENT               | 0.292   | 0.321   | 0.337   | 0.353   | 0.364   |
| AIRFLOW PER UNIT FRONTAL AREA  | 91.33   | 99.23   | 103.60  | 108.20  | 111.38  |
| AIRFLOW PER UNIT ANNULUS AREA  | 99.78   | 108.41  | 113.19  | 118.21  | 121.69  |
| AIRFLOW AT ORIFICE             | 18.51   | 20.11   | 21.00   | 21.93   | 22.57   |
| AIRFLOW AT IGV INLET           | 18.50   | 20.15   | 21.04   | 21.95   | 22.59   |
| AIRFLOW AT ROTOR INLET         | 17.92   | 19.63   | 20.56   | 21.46   | 22.12   |
| AIRFLOW AT ROTOR OUTLET        | 18.00   | 19.99   | 20.31   | 20.43   | 21.07   |
| AIRFLOW AT STATOR OUTLET       | 18.42   | 19.98   | 20.68   | 21.46   | 22.13   |
| ROTATIVE SPEED                 | 10877.8 | 10875.1 | 10867.0 | 10869.3 | 10873.2 |
| PERCENT OF DESIGN SPEED        | 99.9    | 99.9    | 99.8    | 99.8    | 99.9    |
| COMPRESSOR PERFORMANCE         |         |         |         |         |         |
| STAGE TOTAL PRESSURE RATIO     | 1.235   | 1.204   | 1.179   | 1.143   | 1.110   |
| STAGE TOTAL TEMPERATURE RATIO  | 1.081   | 1.068   | 1.061   | 1.052   | 1.045   |
| STAGE ADIABATIC EFFICIENCY     | 0.766   | 0.800   | 0.791   | 0.742   | 0.665   |

TABLE VIII. - Concluded. OVERALL PERFORMANCE OF STAGE 57M2H

(d) 90 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0705   |
| IGV TOTAL PRESSURE RATIO       | 0.991  |
| ROTOR TOTAL PRESSURE RATIO     | 1.229  |
| STATOR TOTAL PRESSURE RATIO    | 0.973  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.068  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.896  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.974  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.279  |
| FLOW COEFFICIENT               | 0.292  |
| AIRFLOW PER UNIT FRONTAL AREA  | 82.08  |
| AIRFLOW PER UNIT ANNULUS AREA  | 89.68  |
| AIRFLOW AT ORIFICE             | 16.64  |
| AIRFLOW AT IGV INLET           | 16.63  |
| AIRFLOW AT ROTOR INLET         | 16.17  |
| AIRFLOW AT ROTOR OUTLET        | 16.16  |
| AIRFLOW AT STATOR OUTLET       | 16.67  |
| ROTATIVE SPEED                 | 9730.4 |
| PERCENT OF DESIGN SPEED        | 89.4   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.185 |
| STAGE TOTAL TEMPERATURE RATIO | 1.064 |
| STAGE ADIABATIC EFFICIENCY    | 0.770 |

(e) 80 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0706   |
| IGV TOTAL PRESSURE RATIO       | 0.993  |
| ROTOR TOTAL PRESSURE RATIO     | 1.180  |
| STATOR TOTAL PRESSURE RATIO    | 0.979  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.054  |
| STATOR TOTAL TEMPERATURE RATIO | 0.998  |
| ROTOR ADIABATIC EFFICIENCY     | 0.895  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.985  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.274  |
| FLOW COEFFICIENT               | 0.294  |
| AIRFLOW PER UNIT FRONTAL AREA  | 74.07  |
| AIRFLOW PER UNIT ANNULUS AREA  | 80.93  |
| AIRFLOW AT ORIFICE             | 15.01  |
| AIRFLOW AT IGV INLET           | 15.02  |
| AIRFLOW AT ROTOR INLET         | 14.60  |
| AIRFLOW AT ROTOR OUTLET        | 14.68  |
| AIRFLOW AT STATOR OUTLET       | 14.92  |
| ROTATIVE SPEED                 | 8714.1 |
| PERCENT OF DESIGN SPEED        | 80.0   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.147 |
| STAGE TOTAL TEMPERATURE RATIO | 1.051 |
| STAGE ADIABATIC EFFICIENCY    | 0.783 |

(f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0711   | 0710   | 0709   | 0708   | 0707   |
| IGV TOTAL PRESSURE RATIO       | 0.995  | 0.994  | 0.992  | 0.991  | 0.989  |
| ROTOR TOTAL PRESSURE RATIO     | 1.144  | 1.091  | 1.097  | 1.075  | 1.060  |
| STATOR TOTAL PRESSURE RATIO    | 0.981  | 0.987  | 0.994  | 0.997  | 0.996  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 0.999  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.044  | 1.039  | 1.033  | 1.028  | 1.025  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | 0.997  | 0.996  | 0.996  | 0.996  |
| ROTOR ADIABATIC EFFICIENCY     | 0.897  | 0.885  | 0.811  | 0.736  | 0.680  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.962  | 0.999  | 0.974  | 0.968  | 0.953  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.282  | 0.245  | 0.191  | 0.148  | 0.119  |
| FLOW COEFFICIENT               | 0.280  | 0.319  | 0.352  | 0.377  | 0.394  |
| AIRFLOW PER UNIT FRONTAL AREA  | 62.55  | 71.02  | 78.00  | 83.17  | 86.69  |
| AIRFLOW PER UNIT ANNULUS AREA  | 68.33  | 77.60  | 85.22  | 90.87  | 94.72  |
| AIRFLOW AT ORIFICE             | 12.68  | 14.40  | 15.81  | 16.86  | 17.57  |
| AIRFLOW AT IGV INLET           | 12.71  | 14.42  | 15.86  | 16.90  | 17.62  |
| AIRFLOW AT ROTOR INLET         | 12.28  | 13.94  | 15.33  | 16.31  | 17.01  |
| AIRFLOW AT ROTOR OUTLET        | 12.31  | 14.21  | 15.08  | 15.97  | 16.80  |
| AIRFLOW AT STATOR OUTLET       | 12.60  | 14.22  | 15.38  | 16.33  | 16.98  |
| ROTATIVE SPEED                 | 7696.9 | 7698.7 | 7696.0 | 7687.5 | 7690.7 |
| PERCENT OF DESIGN SPEED        | 70.7   | 70.7   | 70.7   | 70.6   | 70.6   |

## COMPRESSOR PERFORMANCE

|                               |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.117 | 1.103 | 1.081 | 1.062 | 1.044 |
| STAGE TOTAL TEMPERATURE RATIO | 1.042 | 1.034 | 1.029 | 1.024 | 1.019 |
| STAGE ADIABATIC EFFICIENCY    | 0.760 | 0.828 | 0.791 | 0.730 | 0.652 |

(g) 60 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0712   |
| IGV TOTAL PRESSURE RATIO       | 0.994  |
| ROTOR TOTAL PRESSURE RATIO     | 1.101  |
| STATOR TOTAL PRESSURE RATIO    | 0.988  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.031  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.899  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.982  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.269  |
| FLOW COEFFICIENT               | 0.289  |
| AIRFLOW PER UNIT FRONTAL AREA  | 61.01  |
| AIRFLOW PER UNIT ANNULUS AREA  | 61.20  |
| AIRFLOW AT ORIFICE             | 11.35  |
| AIRFLOW AT IGV INLET           | 11.35  |
| AIRFLOW AT ROTOR INLET         | 10.94  |
| AIRFLOW AT ROTOR OUTLET        | 11.12  |
| AIRFLOW AT STATOR OUTLET       | 11.27  |
| ROTATIVE SPEED                 | 6615.9 |
| PERCENT OF DESIGN SPEED        | 60.8   |

## COMPRESSOR PERFORMANCE

|                               |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.084 |
| STAGE TOTAL TEMPERATURE RATIO | 1.030 |
| STAGE ADIABATIC EFFICIENCY    | 0.783 |

TABLE IX. - OVERALL PERFORMANCE OF STAGE 57M21

## (a) 120 Percent of design speed

| READING NUMBER                 | 0729    | 0728    | 0727    | 0726    | 0725    |
|--------------------------------|---------|---------|---------|---------|---------|
| IGV TOTAL PRESSURE RATIO       | 0.967   | 0.963   | 0.959   | 0.955   | 0.953   |
| ROTOR TOTAL PRESSURE RATIO     | 1.403   | 1.363   | 1.301   | 1.256   | 1.228   |
| STATOR TOTAL PRESSURE RATIO    | 0.933   | 0.946   | 0.968   | 0.981   | 0.982   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.998   | 0.998   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.112   | 1.103   | 1.091   | 1.086   | 1.081   |
| STATOR TOTAL TEMPERATURE RATIO | 1.000   | 1.000   | 0.999   | 0.993   | 0.991   |
| ROTOR ADIABATIC EFFICIENCY     | 0.906   | 0.900   | 0.856   | 0.786   | 0.745   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.966   | 0.976   | 0.995   | 0.983   | 0.948   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.269   | 0.243   | 0.203   | 0.174   | 0.156   |
| FLOW COEFFICIENT               | 0.262   | 0.273   | 0.286   | 0.296   | 0.298   |
| AIRFLOW PER UNIT FRONTAL AREA  | 98.05   | 101.89  | 106.17  | 108.87  | 110.06  |
| AIRFLOW PER UNIT ANNULUS AREA  | 107.12  | 111.32  | 116.00  | 118.95  | 120.25  |
| AIRFLOW AT ORIFICE             | 19.87   | 20.65   | 21.52   | 22.07   | 22.31   |
| AIRFLOW AT IGV INLET           | 19.84   | 20.61   | 21.48   | 22.06   | 22.26   |
| AIRFLOW AT ROTOR INLET         | 19.60   | 20.32   | 21.23   | 21.74   | 21.88   |
| AIRFLOW AT ROTOR OUTLET        | 19.04   | 19.71   | 20.61   | 21.46   | 21.71   |
| AIRFLOW AT STATOR OUTLET       | 19.50   | 20.68   | 21.54   | 22.69   | 22.71   |
| ROTATIVE SPEED                 | 13101.6 | 13103.2 | 13094.3 | 13083.5 | 13092.3 |
| PERCENT OF DESIGN SPEED        | 120.4   | 120.4   | 120.3   | 120.2   | 120.3   |

| COMPRESSOR PERFORMANCE        |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.265 | 1.242 | 1.208 | 1.176 | 1.149 |
| STAGE TOTAL TEMPERATURE RATIO | 1.111 | 1.101 | 1.089 | 1.077 | 1.070 |
| STAGE ADIABATIC EFFICIENCY    | 0.627 | 0.632 | 0.627 | 0.618 | 0.580 |

## (b) 110 Percent of design speed

| READING NUMBER                 | 0724    | 0723    | 0722    | 0721    | 0720    |
|--------------------------------|---------|---------|---------|---------|---------|
| IGV TOTAL PRESSURE RATIO       | 0.971   | 0.968   | 0.965   | 0.963   | 0.960   |
| ROTOR TOTAL PRESSURE RATIO     | 1.322   | 1.285   | 1.248   | 1.217   | 1.187   |
| STATOR TOTAL PRESSURE RATIO    | 0.949   | 0.963   | 0.978   | 0.982   | 0.980   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.093   | 1.083   | 1.078   | 1.072   | 1.065   |
| STATOR TOTAL TEMPERATURE RATIO | 0.999   | 0.999   | 0.996   | 0.994   | 0.992   |
| ROTOR ADIABATIC EFFICIENCY     | 0.897   | 0.892   | 0.839   | 0.807   | 0.769   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.968   | 0.981   | 0.998   | 0.998   | 0.983   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.259   | 0.230   | 0.202   | 0.177   | 0.154   |
| FLOW COEFFICIENT               | 0.267   | 0.281   | 0.294   | 0.304   | 0.311   |
| AIRFLOW PER UNIT FRONTAL AREA  | 91.55   | 95.71   | 99.84   | 102.83  | 105.11  |
| AIRFLOW PER UNIT ANNULUS AREA  | 100.02  | 104.57  | 109.07  | 112.34  | 114.83  |
| AIRFLOW AT ORIFICE             | 18.56   | 19.40   | 20.24   | 20.84   | 21.30   |
| AIRFLOW AT IGV INLET           | 18.53   | 19.43   | 20.23   | 20.83   | 21.30   |
| AIRFLOW AT ROTOR INLET         | 18.06   | 19.01   | 19.85   | 20.49   | 20.91   |
| AIRFLOW AT ROTOR OUTLET        | 17.70   | 18.54   | 19.41   | 20.33   | 20.95   |
| AIRFLOW AT STATOR OUTLET       | 18.27   | 19.33   | 20.45   | 21.17   | 21.40   |
| ROTATIVE SPEED                 | 11961.0 | 11951.0 | 11942.4 | 11937.3 | 11931.5 |
| PERCENT OF DESIGN SPEED        | 109.9   | 109.8   | 109.7   | 109.7   | 109.6   |

| COMPRESSOR PERFORMANCE        |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.219 | 1.197 | 1.178 | 1.151 | 1.117 |
| STAGE TOTAL TEMPERATURE RATIO | 1.090 | 1.081 | 1.072 | 1.064 | 1.055 |
| STAGE ADIABATIC EFFICIENCY    | 0.647 | 0.653 | 0.662 | 0.643 | 0.583 |

## (c) 100 Percent of design speed

| READING NUMBER                 | 0719    | 0718    | 0717    | 0716    | 0715    |
|--------------------------------|---------|---------|---------|---------|---------|
| IGV TOTAL PRESSURE RATIO       | 0.976   | 0.974   | 0.971   | 0.967   | 0.965   |
| ROTOR TOTAL PRESSURE RATIO     | 1.269   | 1.244   | 1.212   | 1.175   | 1.155   |
| STATOR TOTAL PRESSURE RATIO    | 0.956   | 0.967   | 0.981   | 0.983   | 0.982   |
| IGV TOTAL TEMPERATURE RATIO    | 0.999   | 0.999   | 0.999   | 0.999   | 0.999   |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.078   | 1.071   | 1.066   | 1.058   | 1.054   |
| STATOR TOTAL TEMPERATURE RATIO | 0.998   | 0.999   | 0.997   | 0.994   | 0.992   |
| ROTOR ADIABATIC EFFICIENCY     | 0.906   | 0.904   | 0.856   | 0.808   | 0.770   |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.971   | 0.989   | 1.004   | 1.006   | 0.985   |
| ROTOR HEAD-RISE COEFFICIENT    | 0.259   | 0.235   | 0.206   | 0.171   | 0.151   |
| FLOW COEFFICIENT               | 0.269   | 0.281   | 0.295   | 0.311   | 0.319   |
| AIRFLOW PER UNIT FRONTAL AREA  | 84.82   | 88.50   | 92.42   | 97.08   | 99.25   |
| AIRFLOW PER UNIT ANNULUS AREA  | 92.67   | 96.69   | 100.97  | 106.06  | 108.44  |
| AIRFLOW AT ORIFICE             | 17.19   | 17.94   | 18.73   | 19.68   | 20.12   |
| AIRFLOW AT IGV INLET           | 17.16   | 17.90   | 18.71   | 19.66   | 20.11   |
| AIRFLOW AT ROTOR INLET         | 16.71   | 17.45   | 18.32   | 19.26   | 19.70   |
| AIRFLOW AT ROTOR OUTLET        | 16.36   | 17.12   | 17.86   | 19.13   | 19.67   |
| AIRFLOW AT STATOR OUTLET       | 16.84   | 17.78   | 18.83   | 19.77   | 20.02   |
| ROTATIVE SPEED                 | 10947.9 | 10948.9 | 10941.2 | 10931.4 | 10943.3 |
| PERCENT OF DESIGN SPEED        | 100.6   | 100.6   | 100.5   | 100.4   | 100.5   |

| COMPRESSOR PERFORMANCE        |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.185 | 1.172 | 1.154 | 1.118 | 1.095 |
| STAGE TOTAL TEMPERATURE RATIO | 1.076 | 1.069 | 1.062 | 1.050 | 1.045 |
| STAGE ADIABATIC EFFICIENCY    | 0.656 | 0.670 | 0.677 | 0.641 | 0.588 |

TABLE IX. - Concluded. OVERALL PERFORMANCE OF STAGE 57M21

| (d) 90 Percent of design speed |        | (e) 80 Percent of design speed |        |
|--------------------------------|--------|--------------------------------|--------|
| READING NUMBER                 | 0732   | READING NUMBER                 | 0735   |
| IGV TOTAL PRESSURE RATIO       | 0.981  | IGV TOTAL PRESSURE RATIO       | 0.985  |
| ROTOR TOTAL PRESSURE RATIO     | 1.209  | ROTOR TOTAL PRESSURE RATIO     | 1.163  |
| STATOR TOTAL PRESSURE RATIO    | 0.963  | STATOR TOTAL PRESSURE RATIO    | 0.973  |
| IGV TOTAL TEMPERATURE RATIO    | 0.999  | IGV TOTAL TEMPERATURE RATIO    | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.062  | ROTOR TOTAL TEMPERATURE RATIO  | 1.049  |
| STATOR TOTAL TEMPERATURE RATIO | 0.999  | STATOR TOTAL TEMPERATURE RATIO | 0.999  |
| ROTOR ADIABATIC EFFICIENCY     | 0.900  | ROTOR ADIABATIC EFFICIENCY     | 0.903  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.971  | ROTOR MOMENTUM-RISE EFFICIENCY | 0.972  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.253  | ROTOR HEAD-RISE COEFFICIENT    | 0.250  |
| FLOW COEFFICIENT               | 0.269  | FLOW COEFFICIENT               | 0.269  |
| AIRFLOW PER UNIT FRONTAL AREA  | 76.29  | AIRFLOW PER UNIT FRONTAL AREA  | 68.16  |
| AIRFLOW PER UNIT ANNULUS AREA  | 83.35  | AIRFLOW PER UNIT ANNULUS AREA  | 74.46  |
| AIRFLOW AT ORIFICE             | 15.46  | AIRFLOW AT ORIFICE             | 13.81  |
| AIRFLOW AT IGV INLET           | 15.44  | AIRFLOW AT IGV INLET           | 13.79  |
| AIRFLOW AT ROTOR INLET         | 14.98  | AIRFLOW AT ROTOR INLET         | 13.37  |
| AIRFLOW AT ROTOR OUTLET        | 14.78  | AIRFLOW AT ROTOR OUTLET        | 13.12  |
| AIRFLOW AT STATOR OUTLET       | 15.28  | AIRFLOW AT STATOR OUTLET       | 13.62  |
| ROTATIVE SPEED                 | 9788.4 | ROTATIVE SPEED                 | 8711.0 |
| PERCENT OF DESIGN SPEED        | 89.9   | PERCENT OF DESIGN SPEED        | 80.0   |

| COMPRESSOR PERFORMANCE        |       | COMPRESSOR PERFORMANCE        |       |
|-------------------------------|-------|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.142 | STAGE TOTAL PRESSURE RATIO    | 1.114 |
| STAGE TOTAL TEMPERATURE RATIO | 1.040 | STAGE TOTAL TEMPERATURE RATIO | 1.048 |
| STAGE ADIABATIC EFFICIENCY    | 0.646 | STAGE ADIABATIC EFFICIENCY    | 0.658 |

## (f) 70 Percent of design speed

|                                |        |        |        |        |        |
|--------------------------------|--------|--------|--------|--------|--------|
| READING NUMBER                 | 0737   | 0742   | 0741   | 0740   | 0739   |
| IGV TOTAL PRESSURE RATIO       | 0.988  | 0.985  | 0.983  | 0.981  | 0.979  |
| ROTOR TOTAL PRESSURE RATIO     | 1.120  | 1.101  | 1.083  | 1.069  | 1.056  |
| STATOR TOTAL PRESSURE RATIO    | 0.982  | 0.990  | 0.992  | 0.990  | 0.990  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  | 1.000  | 0.999  | 0.999  | 0.999  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.075  | 1.031  | 1.027  | 1.024  | 1.021  |
| STATOR TOTAL TEMPERATURE RATIO | 1.000  | 0.999  | 0.998  | 0.997  | 0.997  |
| ROTOR ADIABATIC EFFICIENCY     | 0.911  | 0.895  | 0.851  | 0.808  | 0.738  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.983  | 1.021  | 1.035  | 1.017  | 0.972  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.241  | 0.203  | 0.166  | 0.139  | 0.113  |
| FLOW COEFFICIENT               | 0.275  | 0.302  | 0.325  | 0.342  | 0.354  |
| AIRFLOW PER UNIT FRONTAL AREA  | 61.00  | 66.72  | 71.76  | 75.47  | 78.12  |
| AIRFLOW PER UNIT ANNULUS AREA  | 66.65  | 72.89  | 78.40  | 82.46  | 85.35  |
| AIRFLOW AT ORIFICE             | 12.36  | 13.52  | 14.54  | 15.30  | 15.83  |
| AIRFLOW AT IGV INLET           | 12.37  | 13.53  | 14.57  | 15.32  | 15.85  |
| AIRFLOW AT ROTOR INLET         | 11.98  | 13.14  | 14.15  | 14.86  | 15.34  |
| AIRFLOW AT ROTOR OUTLET        | 11.74  | 12.97  | 14.09  | 14.96  | 15.37  |
| AIRFLOW AT STATOR OUTLET       | 12.20  | 13.46  | 14.40  | 14.96  | 15.35  |
| ROTATIVE SPEED                 | 7605.7 | 7613.5 | 7637.6 | 7633.8 | 7640.6 |
| PERCENT OF DESIGN SPEED        | 69.9   | 69.9   | 70.2   | 70.1   | 70.2   |

| COMPRESSOR PERFORMANCE        |       |       |       |       |       |
|-------------------------------|-------|-------|-------|-------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.086 | 1.074 | 1.057 | 1.038 | 1.024 |
| STAGE TOTAL TEMPERATURE RATIO | 1.036 | 1.030 | 1.025 | 1.020 | 1.017 |
| STAGE ADIABATIC EFFICIENCY    | 0.669 | 0.680 | 0.644 | 0.535 | 0.389 |

## (g) 60 Percent of design speed

|                                |        |
|--------------------------------|--------|
| READING NUMBER                 | 0743   |
| IGV TOTAL PRESSURE RATIO       | 0.991  |
| ROTOR TOTAL PRESSURE RATIO     | 1.085  |
| STATOR TOTAL PRESSURE RATIO    | 0.988  |
| IGV TOTAL TEMPERATURE RATIO    | 1.000  |
| ROTOR TOTAL TEMPERATURE RATIO  | 1.026  |
| STATOR TOTAL TEMPERATURE RATIO | 1.000  |
| ROTOR ADIABATIC EFFICIENCY     | 0.915  |
| ROTOR MOMENTUM-RISE EFFICIENCY | 0.991  |
| ROTOR HEAD-RISE COEFFICIENT    | 0.233  |
| FLOW COEFFICIENT               | 0.281  |
| AIRFLOW PER UNIT FRONTAL AREA  | 53.34  |
| AIRFLOW PER UNIT ANNULUS AREA  | 53.29  |
| AIRFLOW AT ORIFICE             | 10.81  |
| AIRFLOW AT IGV INLET           | 10.84  |
| AIRFLOW AT ROTOR INLET         | 10.46  |
| AIRFLOW AT ROTOR OUTLET        | 10.35  |
| AIRFLOW AT STATOR OUTLET       | 10.74  |
| ROTATIVE SPEED                 | 6512.7 |
| PERCENT OF DESIGN SPEED        | 59.8   |

| COMPRESSOR PERFORMANCE        |       |
|-------------------------------|-------|
| STAGE TOTAL PRESSURE RATIO    | 1.062 |
| STAGE TOTAL TEMPERATURE RATIO | 1.026 |
| STAGE ADIABATIC EFFICIENCY    | 0.682 |

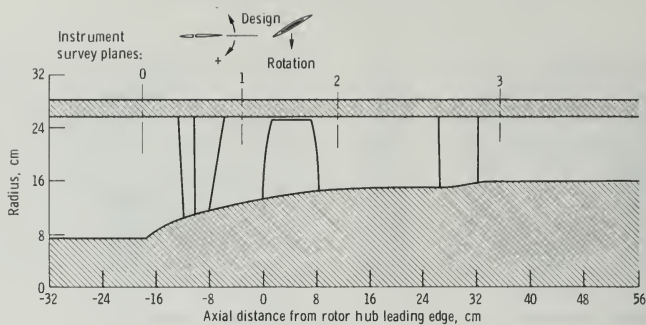


Figure 1. - Flow path for stage 57M2.

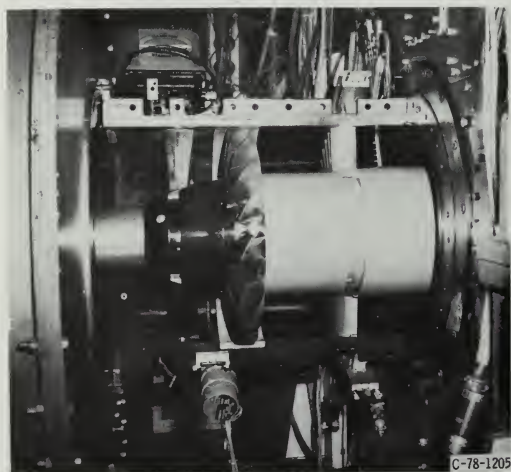


Figure 2. - Test stage.

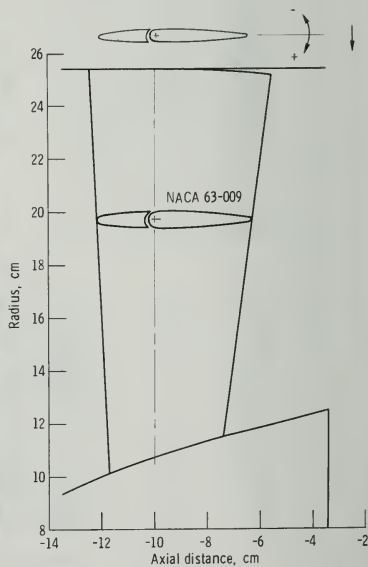
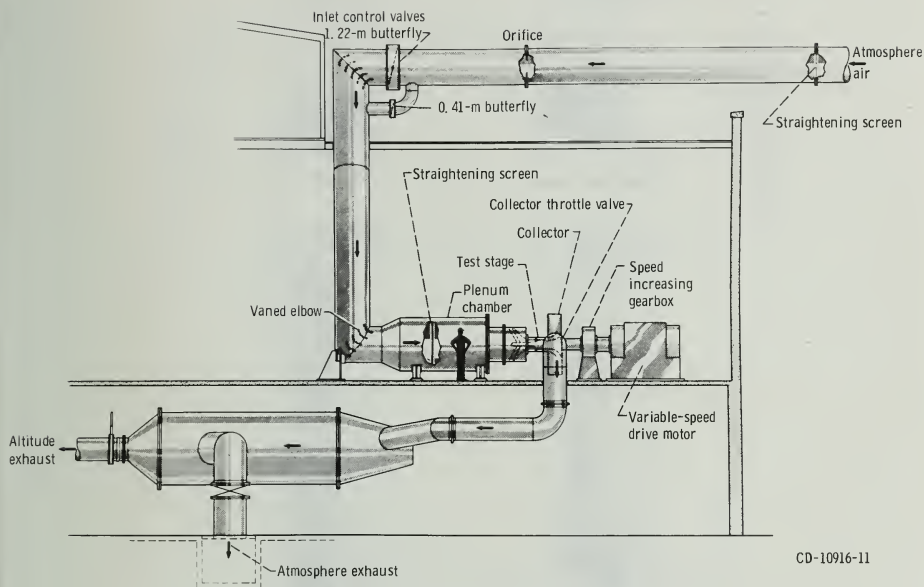
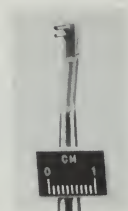


Figure 3. - Schematic of variable-inlet-guide vane.



CD-10916-11

Figure 4. - Single-stage compressor test facility.



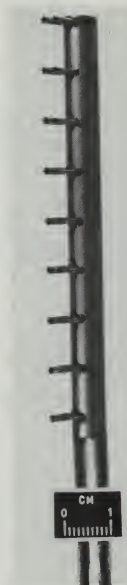
(a) Combination probe.



(b) Wedge static probe.



(c) Station 1 rake.



(d) Station 3 rake.

Figure 5. - Instrumentation

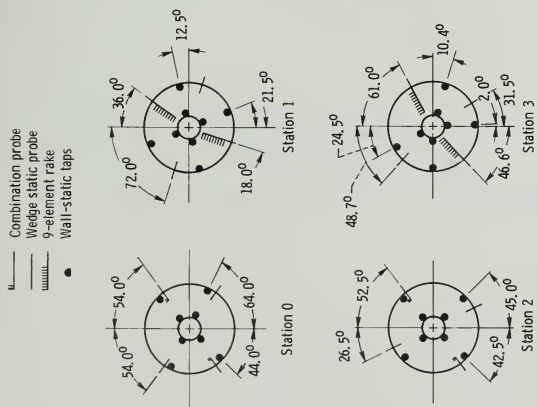


Figure 6. - Circumferential location of instrumentation (looking downstream).

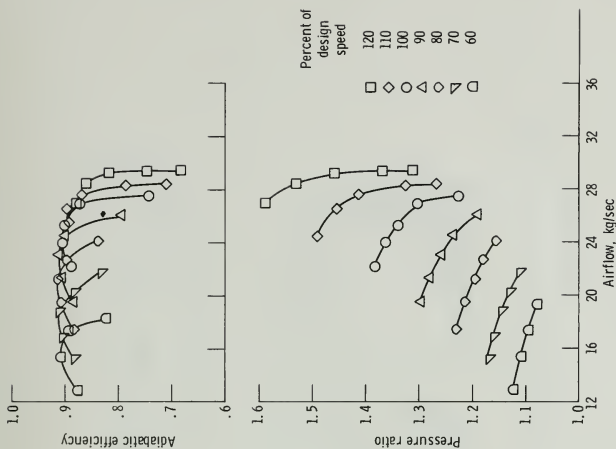


Figure 7. - Overall performance of rotor 57M2A (IGV angle, 0°; rotor blade setting angle, 6°; closes).

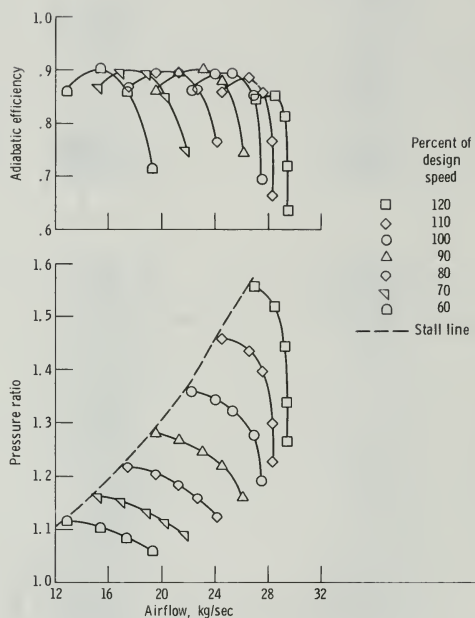
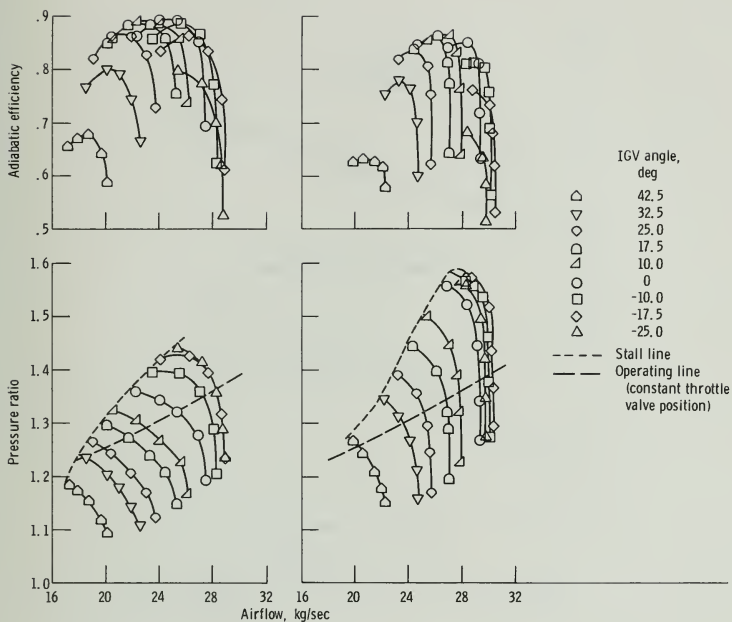


Figure 8. - Overall performance of stage 57M2A (IGV angle,  $0^\circ$ ).



(a) 100 Percent of design speed.

(b) 120 Percent of design speed.

Figure 9. - Effect of inlet-guide-vane angle on overall stage performance.

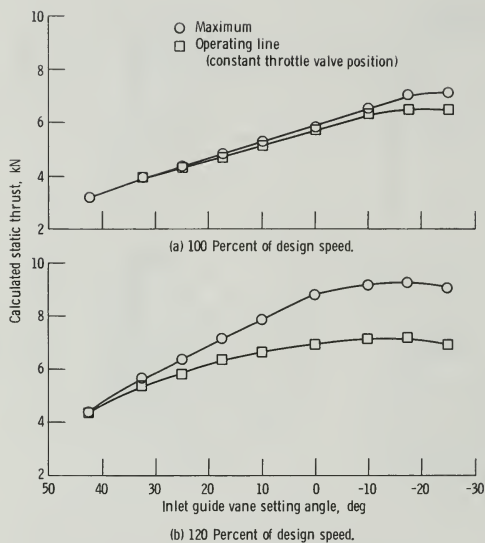


Figure 10. - Effect of inlet guide vane angle on calculated static thrust.



|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |                                                      |                                                                            |                                                          |  |
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| 16. Abstract<br><p>The overall performance of a fan stage with nine inlet-guide-vane angle settings is presented. These data were obtained over the stable flow range at speeds from 60 to 120 percent of design for vane setting angles from <math>-25^{\circ}</math> to <math>42.5^{\circ}</math>. At design speed and design inlet guide vane angle, the stage had a peak efficiency of 0.892 at a pressure ratio of 1.322 and a flow of 25.31 kilograms per second. The stall margin based on peak efficiency and stall was 20 percent. Based on an operating line passing through the peak efficiency point at the design setting angle, the useful operating range of the stage at design speed is limited by stall at the positive setting angles and by choke at the negative angles. At design speed the calculated static thrust along the operating line varied from 68 to 114 percent of that obtained at design setting angle.</p> |  |                                                      |                                                                            |                                                          |  |
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